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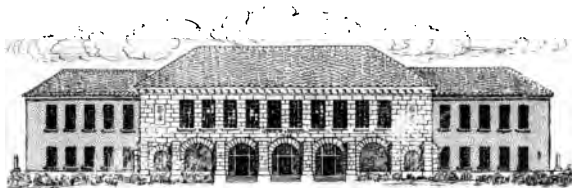
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LITTLE FLOWER- PEOPLE

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A HAUNT OF THE ELFIN FERNS. IN CASCADILLA RAVINE, ITHACA, NEW YORK.

LITTLE FLOWER-PEOPLE.

BY

GERTRUDE ELISABETH HALE.

Everywhere about us are they glowing,
Some like stars, to tell us Spring is born;
Others, their blue eyes with tears o'erflowing,
Stand like Ruth amid the golden corn;

* * * * *

In all places, then, and in all seasons,
Flowers expand their light and soul-like wings,
Teaching us, by most persuasive reasons,
How akin they are to human things.

— *Longfellow.*

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TO MY LITTLE NEPHEW,

Swinburne Hale,

These sketches of the Flower-People are affectionately
dedicated, with a hope that in future years Casca-
dilla Woods, with their ravine, rushes, ferns,
and flowers, may be associated in
his mind with thoughts of

"NANA."

PREFACE.



SINCE those early days when the trees and flowers of a certain far-away wood and hill were her dearest companions, it has always been a favorite idea of the writer that, in and out of a thin warp of fancy, certain elementary facts connected with flower-life might be so woven, that not only should that feeling which led the poet to say

“And ’tis my faith that every flower
Enjoys the air it breathes,”

not be lost out of the childish mind, but also that an interest might be awakened in the facts themselves, — an interest which would surely prove a rich source of pleasure for many an hour in later life.

Through the kindness of Professor William R. Dudley, of Cornell University, the writer, though not one of his students, has been able to collect for herself, in laboratory and field, the materials necessary for the weaving of that little web of fact and fancy of whose possibility she once dreamed; but it remains now to be seen by the young readers of these sketches, whether her weaving has been strong enough to make the web answer its intended purpose.

ITHACA, N.Y., January 6, 1887.

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LITTLE FLOWER-PEOPLE.



CHAPTER I.

INTRODUCTION.

COME and sit down here beside me. I have a most charming secret to tell you.

Every — little — flower — that — grows — is — just — as — much — a — living — talking — being — as — you — or — I.

Isn't this a lovely secret to know? And how do I know it, do I hear you ask?

Listen now. You all know the creek, which, coming merrily down through the woods, over the dam, under the foot-walk, under the high stone bridge, dances down the "Giant Stairs," and then dashes headlong into the deep valley below. Do you remember the rustic steps, half-way between the two bridges, just beyond the patch of tangled greenbrier and the place where the long-spurred violets grow? You ought to remember them well, for many a time have some of us sat there, looking down into the ravine, watching the squirrels running along the dripping, fern-covered rocks below, and listening to the murmur of the tiny cascade a little farther up. How incredulous you used to look when I told you that an imprisoned water-spirit was

trying to tell us some wonderful woodland secret, which she would surely reveal if you would only keep quiet long enough. But with many smiles, and a few "Oh's!" and "Ah's!" you would go on talking, until at length the eager voice of the tired water-spirit subsided into a low-toned murmur of disappointment, while you laughed and chatted amongst yourselves on the bank above.

But I was wiser and more patient than you, and one lovely morning, with the birds singing joyously around me; with the golden sunbeams peering down from leafy hiding-places in the trees, whose slender, graceful branches were gayly tossing and waving in the morning breeze; with every little blade of grass, every opening leaf, every tiny bit of moss at my feet, looking up at me with twinkling eyes, as if to say, "Oh, couldn't I tell you something, if I only would!" I sat down on the old steps again. Again I looked into the ravine as we had done only a few days before. There were the very same little squirrels running about; the very same little clusters of ferns were still inviting me down into their cool and quiet homes; and — yes — there was the very same little water-spirit still calling — calling — calling —. What was she saying? What was she trying to tell me? Eager, breathless, I listened. "Wait! wait!" solemnly rustled the ancient hemlocks over opposite. "Wait and listen! wait and listen!" sang the birds. "Oh listen! listen! She will tell you. She will tell you!" was tossed and waved to me from every gladsome bough. "Listen! listen!" looked up at me from every dewy bit of green at my feet. Hush! Was she speaking? Yes — yes — at last — at last —.

* * * * *

Into what enchanted world had I been taken! What were all these myriads of tiny voices calling—nay, rather breathing—sweet secrets to me! And what did SHE reveal to me—that wonderful spirit! Ah! That is what I can never, never tell you. You must learn that for yourselves, and in the same way that I did. But there is one thing about which I can tell you, and that is the gift that she left with me.

You must know that in olden times; when the fairy world was still a part of ours, the favored mortal who met with one of its mystic inhabitants always had a right to ask and receive some fairy gift; and this is just as true now as then. So what do you suppose I asked for? It was that I might know what my little field and woodland companions were saying and doing, as I walked among them day by day.

The little water-fairy only smiled when I asked for this, and, waving her wand, began a song so full of plaintive loveliness, so burdened with mysterious meaning, that I sat as one entranced, until, with a deep breath, I lifted my head and realized that she had vanished. The sunbeams no longer played hide-and-seek above me; the trees stood quiet, their branches no longer tossing gayly to and fro; the squirrels had stopped their running, and were looking up at me with sharp, inquisitive eyes; while the birds sat silent on the motionless boughs. Everything was hushed. All seemed waiting—for what? Suddenly a faint sound of moaning seemed to arise from the ground, and there, at my feet, lay a little broken-stemmed violet, with a great tear still standing in her blue eye. Hardly believing it could have

been she from whom that plaintive sound had come, I gently lifted her up in my hand.

"Why, dear little Violet, what is the matter? Does it hurt you to have been taken from your home and friends? But I thought that all the flowers liked being carried away among people."

"Ah, that is just it," was her low reply. "It is not because I am so far from home that I am crying, but because I am left to die here alone and unnoticed, without ever having seen anything of what lies beyond these quiet woods."

"No, no, little Violet," said I; "you shall have a better fate than that. I know the blue-eyed little girl who held you so carelessly, and I strongly suspect that she was on her way to my house with you all. I will take you there myself, and I think we shall meet her and your companions again."

The Violet quickly raised her drooping head and, with sparkling eyes, exclaimed, "O dear, kind lady, you make me so happy! Will you really take me to your own home, yourself? Oh, now I am so glad that the little girl did drop me, because I couldn't have talked with her at all, and you understand everything that I say. But won't you please tell her that we flower-people are really and truly alive, and that, while we like to be taken, it hurts us dreadfully to be dropped by the way and left to die like common weeds? She would never do it again if she thought it hurt us, I know, for I am sure she is very tender-hearted and loves us dearly."

"You may be very certain that I shall tell her everything you say," I replied with a smile, as I walked along carrying the little

Violet, who now seemed fairly overflowing with happiness. All the way homeward she prattled joyously about herself and her friends; but I did not tell you then what she said, because I was waiting for just such a time as this. I wished to find an hour when I could have you all around me, as now, when I told you that not only do your beloved flowers know everything that you do or say when with them, but that they are also constantly calling and talking to you as you pass by. Oftentimes, if you should notice them closely, you would see their eyes filling with great tears of disappointment, as, finding their eager calling unheard, or unnoticed, they sadly turn back to await the coming of some friendly bee or butterfly, into whose sympathizing ears they may tell the story of their grief. The older people, it is true, who do not believe that any one can talk or cry but ourselves, would call these tears *dew*, and they would say the bees were only selfishly gathering honey, instead of comforting the sorrowful flower; but never mind. You and I and the flowers know better.

Before I tell you what the little Violet said about herself, however, I must tell you that the flowers do not talk as we do. As with ourselves, it is true, every motion, every change of expression, the very air and attitude, even, of the little plant as it stands looking out from its home, speaks in the most eloquent manner to the passer-by. Unlike ourselves, however, they cannot express their thoughts aloud. Where ours would be expressed in loud, clear words, their thoughts must come in a gentle, odorous breathing. We *feel*, rather than hear, what they wish to say. And the little flower-people are so different from us,

that it seems almost hopeless to try to compare them with ourselves; still, this is what I shall try to do for you.

First, then, you must know that the flower race, like the human, is divided into very many great families, of which each kind of flower plant forms a distinct member, bearing its own special name, and every plant of each kind having its own little home to itself; but these flower homes are very different from ours. Our houses, you know, are built above ground, with the exception of a cellar or store-house; but their house is often all cellar, and there is nothing at all above ground except a great, open balcony, upon which the little flowers live and sleep. So much, however, do some of the flower plants dislike the dark ground, that they build even their store-houses entirely out in the open air, spreading themselves largely in it and only entering the ground at one place.

Another great difference is that while we are perfectly well able to perform all the ordinary acts of life for ourselves, the flowers are very helpless, and nearly everything must be done for them in order to enable them to live at all. What would you think if you could not even breathe for yourself, to say nothing of being unable to do your own eating and drinking? But these three necessary things cannot be done by the little flower herself; so every bud and blossom must be surrounded by a large number of servants, who must cheerfully take upon themselves the duty of keeping their mistress in perfect health.

Like the young "buds" of the human family, every little flower bud is expected, once in her life, to "come out"; but to the young girl-bud, who continues, ever afterward, to remain "in

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Like the young "buds" of the human family, every little flower bud is expected, once in her life, to "come out"; but to the young girl-bud, who continues, ever afterward, to remain "in

society," the particular month of her coming out makes little difference. Not so with the flower buds, however. They have their own rigid ideas upon this subject, which they carry out with the greatest exactness. Each family has its own unchanging seasons, the punctual observance of which is a matter of great flower pride. Whether it may be according to ancient traditions or precepts handed down from plant to plant; a scorn of our more common, less exclusive ways; or in obedience to some secret law governing their world; it is certain that they are not to be prevented from following out this one strict point of flower etiquette; and I suppose we might as well look for a snow-storm in August, as a wake-robin in October, or a cardinal flower in May.

Some of the flowers, like the daisies and buttercups, remain out a much longer time than do others; but you will find in most cases that these are considered to belong to the more common classes; for there are marked degrees of aristocracy among these flower-people. As a general rule, the greater the pride which the little flower has in her race, the sooner, Cinderella-like, she drops her fine clothing and retreats to some dark nook, there to dream over again all that she saw and heard during her one brief season of gayety.

So much for three great differences between the flowers and ourselves, — the construction of their homes; the absolute necessity for a large number of servants; and the exactness of the time of their "coming out," and the shortness of their "season" of gayety.

Now what do you suppose is the reason that the little flower

is considered so precious a charge, that all her servants will willingly endure any hardship or death for themselves in order that the life of their beloved mistress may be preserved? You will at once guess that she must have something to do of far more importance than their work, and probably something connected with the life of the whole plant itself; and you will guess rightly.

It is upon this same gay little blossom, idly rocking in the breeze and smiling upon every passer-by, that the new flower plant of the next season depends. To this delicate little flower are entrusted the tiny seeds from which are to spring future plants like her own. Not one of all her servants can carry this sacred charge for her. Upon her alone, tender and fragile as she is, depends the continuation of her race. No wonder that her strong, faithful servants, looking up to her as something far higher than themselves, and knowing that upon the safe keeping of her precious trust depends also the welfare of their own descendants, ask nothing better or higher than to devote themselves and their whole lives to her service. Good, tender, and really unselfish servants they are, too; for if anything should happen to their mistress, and her little seeds be hopelessly lost, they would neither desert her nor their home, but would cling fondly to the old place as long as their failing strength permitted, and then, sinking quietly down, away from sight, would give themselves up to preparing a better, richer home for her successor.

CHAPTER II.

THE FLOWER SERVANTS.

WITH very few exceptions, every plant has three sets of faithful attendants, — the root, stem, and leaf servants, — each having its own distinct place and duty.

First come the root servants, who, though lowest in position, are really, perhaps, the most hard-working and useful of all. At least, while there are a number of flower plants that have to give up either the stem or leaf servants, there are but very few that do not have at least one strong, able-bodied root. And there is a very good reason for this, since one great duty of the roots is to hold the flower home firmly in its place. If anything should destroy these roots, then good-by to the little plant which, even if it were able to live without these servants, would soon find itself with no fixed home, and driven about at the mercy of every passing wind. What do you find when weeding your flower bed? Will pulling off the leaves, or breaking the stem, destroy the troublesome weeds? Isn't it the roots that have to be taken up in order that the whole plant may be destroyed? And the weeds, although only "poor relations" of our flower plants, still belong to the same flower world.

Another great duty of the roots, and perhaps the most important one, is to bring water from the ground for the whole flower household. This is no easy task, I assure you, for the flower

plants are very thirsty, and they have no mercy upon the poor roots. It makes no difference how hot and dry the weather may be; indeed, it is in the very hottest and dryest weather, when to make any extra effort seems an impossibility, that the imperious little flowers call out most loudly, "Water! water!" and the roots must go on toiling in the darkness, digging down farther and farther in search of new springs, until, completely worn out with their efforts, they at length loosen their hold on the crumbling earth, and falling backward, gasp with their dying breath, "There is no more!" With their death, however, there comes also the death of the thoughtless, childish little mistress, who never dreamed to what fatal end her want of self-denial was bringing her.

Think of the poor little root servants, patiently digging down there in the dark earth, when you see your plants wilting and drying for want of water. Take pity on them. Remember that their mistress takes none. But be careful. Do not give too much, or too often. The little flower is very particular about this matter. She wishes, and will take, only just what she wants at a time; so the leaves and roots, not daring to offer her more than they know she is willing to receive, must dispose of the remaining quantity themselves. Imagine how you would feel if, on your asking for a drink of water for yourself and friend, a whole pailful should be brought with a command for you to drink all that your friend leaves. Remember this, and give your plant the amount for which it asks, and no more; or if more, give it in such a way that the poor roots and leaves may not be forced to drink up all that is left.

How do the roots perform these two great duties, — holding the plant in place, and providing it with water? Before answering this, I must tell you that not all the plants have cellars or store-houses. A large number have only the great open balcony, of which I have already spoken, and it is the root servants of the latter class that have the hardest work to do.

When the little plant has decided where its home shall be, its oldest, strongest servants, going downward, choose the positions that seem best for holding the plant in place. Then these in turn send out younger, more active rootlets and fibres to lay hold of the earth far and wide in every direction, until at last nothing but a great tempest or some strong outward force can uproot the little plant.

Did you ever take cider through a straw, or see any one else do so? Well, this is the way in which the roots get water. All the ends of the young, tender rootlets are supplied with very many little hair tubes, which serve the purpose of the straw to the cider-drinker. These hairs are so small that they cannot always be seen by the naked eye, but must be looked at with the aid of a microscope; and it is through these tiny tubes, that nearly all the water used by the whole flower household is slowly sucked up from the surrounding earth.

You will find that the little flower plants are usually very careful in selecting the site of their homes. You will never find those flowers that are always calling for water, settling themselves down in a dry, sandy field. Not they! They go as far off in the bogs and marshes as they can. On the other hand, some of their relatives, who love cheerful homes, and demand only a moderate

been severely punished for their thieving, since they are never allowed to have any leaf servants, or, at least, none but some pallid little cripples that can never give them much help.

THE LEAF SERVANTS AND THEIR DUTIES.

Now comes another class of flower attendants, — the leaves, — who, although they are kept busy, night and day, working for the flower, are yet so closely related to her that it seems hardly right to call them her servants. They are really her foster-brothers and sisters; and it is by them that she expects nearly all her breathing, and much of her eating and digestion, to be done.

Mistress Flower is very particular about the personal appearance of all her attendants; but, while the roots are compelled to wear a livery of the soberest brown, her leaves generally go dressed in shining green. Some plants and trees, like the Woodbine, Poison Ivy, Sumach, Elm, Oak, Beech, and Maple, are very gracious to their leaves; and in the autumn, long after the flower has withdrawn herself from the world, these foster-brothers and sisters of hers are allowed to put on the most gorgeous robes of crimson, yellow, purple, or golden brown, and come out for one long, gay holiday time before the cold winter drives them under shelter.

The most of these favored leaves are usually wise enough to seek their homes before their bitter enemy, snowy-bearded Jack Frost, can get hold of them. Sometimes, however, long after they ought to have followed their mistress, you will see, here and there, a little group of leaves, or a few scattered ones, that, dreading to leave their airy perches for the long winter

sleep, have rashly lingered on until, with a "Ha, ha! Now I have caught you!" Jack's fingers are at their throats. Paralyzed with the cold, the poor things fall helpless and dying to the ground; and, even though we know their own folly has brought this fate upon them, it is really quite impossible to keep from pitying the foolish leaves, as we see their pallid faces upturned to us in mute despair.

These foster-brothers and sisters of the flower are very curious beings. To begin with, many of them are perfect giants in size when compared with their mistress; and it is really touching to see the tender, protecting way in which they try to guard her from injury. The leaves of some of the coarser plants actually become very fierce, if they think their mistress is about to be harmed. Just try to get a Nettle or a Thistle, and see for yourself what its ferocious guardians will do. I know but one of all the thistles, and that is the yellow Sow Thistle (not a true thistle, either), whose leaves will not instantly make you regret touching the flower; but then, these same leaves have always been especially noted for their laziness. Among the most zealous of the thistle leaves are those of the Canada Thistle, which, with true British spirit, cry out "Hands off!" and bristle all over with their dagger-like spines the moment they even fancy an enemy to be approaching.

The very small leaves nearly always found closely attending the flower are called **Flower Bracts**. They are the personal attendants of the blossom, and her inseparable companions, never leaving her alone for even a moment, unless compelled by some great necessity.

Nearly all leaves, like storks, stand upon one leg; but it is for a better reason than any that the bird can give, since the leaf possesses only one. This leg, or **Footstalk** (botanists call it the **Petiole**), is braced firmly against the stem, which is the old nurse of the flower and the great dependence of the whole plant household.

Curiously enough, there are some plants, like the Trillium, or Wake-Robin, whose leaves have not even one footstalk upon which to stand, but are compelled to sit all the time, trusting to Nurse Stem to keep them in position. The good old dame is equal to anything of the kind, however, and makes all sorts of arrangements by which the **Sessile**, or *sitting*, leaves may be comfortable; so, in spite of what we should consider their misfortune, they seem to be fully as well off as their one-footed and taller comrades.

The leaves of some of the flower families cannot endure to be alone for a moment, but insist upon being allowed to come out in groups. Nurse Stem and the Flower Mistress consent to this on certain conditions. Each group is to be called a **Compound Leaf**, each member of that group being known as a **Leaflet**. One of these sociable little leaflets usually stands at the head as the captain or leader, and upon him falls all the responsibility of keeping the leaflets of the group in order and at work. To the whole compound leaf is then given one long petiole, which is firmly supported by the stem, and to which each separate leaflet clings close with its own little footstalk.

In many plant families the leaves themselves are provided with extra attendants, called **Stipules**, who usually stand, one on either side of the footstalk or petiole. They are really little "foot

pages," and, if small, have only to stand quietly beside their master, while, if large enough to do so, they are expected to help him in his important work.

The leaves have two great things to do,—to eat and to breathe, not only for themselves, but also for their mistress. The processes of eating and digestion are quite complex ones with them, and include also the preparation of the meals. With this latter is connected the separating of the pure water from the more solid portions of the food, and the pouring of it off into the open air. This process of expelling



Fig. 2.

Common Red Clover, showing the leaf servants and their foot pages; i.e., the compound leaves and clasping stipules.

the water into the air is important enough to be known by the name of "transpiration," but that is a long word with which we will not trouble ourselves at present.

How do you suppose the leaf does all this eating and breathing? Of course the first thing necessary, you say, is a mouth. Well, it has a mouth. One mouth — it has hundreds of them.

You need not expect to see these mouths unless you can look for them through a microscope; but I assure you that in one square inch of the Garden Rhubarb, no less than five thousand of these tiny mouths were discovered, while in the same space on the leaf of the Hydrangea, there were one — hundred — and — sixty — thousand.

These mouths, called *Stomata*, are usually most abundant on the under, or shaded, side of the leaf, and are also found in all the green parts of the plant which are exposed to the air. They do not open and shut of their own accord, but the opening is guarded by two narrow, lip-like cells which, when the air is moist and the mouth ought to be open, quickly fall apart and leave the mouth free for breathing; while, if the air becomes very dry or dusty, the lips will as quickly come together, and not only prevent any entrance of dust into the now closed stomata, but also, what is of far more importance, prevent that passing off of water into the air, which we have spoken of under the name of “transpiration.”

The leaf itself, you see, has nothing to say about this opening and shutting of its own mouths; but since they are always opened and shut at exactly the right time, it is quite delighted to be freed from all responsibility in the matter.

When the little flower calls out so impatiently for water, it is not simply because she is thirsty, but because she is also very hungry, and a great deal of water is required to prepare her meals, which are always made first in the form of a thin soup.

You know that water is never quite free from some mineral substance; so, when the roots are ordered to get it from the soil,

they are always expected to bring up the particular kind of mineral water which their mistress prefers. If Peas and Wheat should be growing side by side in the same field, the roots of the latter would be expected to send up the water with some silica in it, while the Pea roots would be expected to send up lime in the water; nor would either Pea or Wheat roots ever make a mistake.

This mineral water, after being brought by the rootlets, is sugared and salted, and has all sorts of nice things put into it by trusty servants along the way, and finally Nurse Stem carries this crude or raw soup, which we might as well call **Crude Sap**, up to the leaves. This liquid is usually quite thin and colorless, and of course, tastes different in different plants and trees. You know yourself, probably, how it tastes in the Maple trees, for you have doubtless often drunk the sweet "sugar sap" in the early spring. Remember, however, that though you may enjoy the sweet drink, it is not yet considered ready to eat by the tree itself.

The stem guards this sap very jealously, not only taking every precaution to avoid spilling any on the way, but also carrying the precious fluid concealed from sight as much as possible. Perhaps you remember how far within the stem, or trunk, of the tree it is necessary to pierce, in order to find this maple sap.

Now comes a very odd fact. The leaf, having no hand, is obliged to receive this charge from the nurse *in its foot*, or, if it is a sessile leaf, directly into the *veins*. From the foot it is passed carefully on through the footstalk and then on, on, — higher and higher, — by the veins leading out in every direction from the petiole, until at last it is carried safe into all the countless little cell workshops, or laboratories, of the leaf.

These laboratories are very small, cell-like compartments, placed side by side, and end to end, and separated only by their thin walls. In these close-locked little rooms the mysterious operations of thickening and stirring this crude sap and manufacturing new substances out of it, goes on, until the solid parts have become changed into a peculiar, thick, starchy mass, which is the kind of food preferred above everything else by the little flower. When this starchy part is just right, the extra water is poured off into the air by the process of "transpiration," of which I have spoken, and the flower household is called for its meal. Then the stem hurries about on her pleasant task of giving to each hungry member, in turn, his share of the delicious food, nor does she ever make a mistake in this distribution, no matter how large the household may be.

The roots, who were the first to begin work, are the very last to be fed. They have a great trust given to them, however, for the food remaining after the whole household has been supplied is usually put away in the store-house and left in their charge. They are then expected to guard it from any possible invasion by plants like the Broom Rapes or the Cancer Roots.



Fig. 3.

Leaf servants of Houseleek, in whose inner cells is stored the extra food of the household.

A few fleshy-leaved plants, like the Cactus and the Houseleek, have a curious way of storing up their extra food within the *inner cells*

of their leaves, leaving only the outside ones free for carrying on the work of its preparation. If you will strip off the outer green coverings of these useful, but certainly not very graceful, leaves, you will find a great quantity of this thick, starchy food safely packed away for the future use of the household.

Those gay little plants that allow their flowers to come out the first year, and that think nothing about laying up a store of provisions for a possible need, usually live rather a "hand-to-mouth" existence from day to day. The more thrifty, hard-working plants, however, whose flowers are not allowed to come out until after the first year, have a habit of storing up food in their larder which proves to be a very fortunate one for us. I don't think the Beets, Turnips, Parsnips, Carrots, or Radishes, fill up their store-houses for us, do you? Nevertheless, it is certainly we who reap the benefit of their industry and forethought.

I wonder if you know how necessary the plants and trees are to us. Men and animals are continually breathing out from their lungs a very poisonous gas, called carbonic acid gas. Now, just think what would happen, after a while, if there were no way of getting rid of this terrible poison thus set free in the world. Think what a blessing it is to mankind that this very gas, which is sure death to man, if it enters his lungs in any great quantity, is exactly what the little plant likes.

There is a most friendly exchange of helpful offices between the people of the plant and those of the human world; for not only does man give out the carbonic acid gas which the plant seizes upon, but the plant, in its turn, offers the pure oxygen which

it is absolutely necessary that man should breathe in order to live. Curiously enough, however, it is only in the sunlight that the little plant is willing to perform its share in this friendly interchange of kindnesses. If left in the darkness, it will itself seize upon the oxygen in the air, and send out some of the poisonous gas; but this is not wholly due to selfishness, because the plant really cannot live without some oxygen; and it is only in the light that it can easily get enough to supply its own needs, to say nothing of being able to furnish some for the use of man. No wonder, then, that the plants hate the darkness, which means to them, if long continued, a lingering death, with all the horrors of slow starvation. You know how pale they become after a few cloudy days, and how quickly they recover their natural color and good spirits upon the return of sunshine. And have you never noticed how eagerly the little potato sprout will lift itself up to the sympathizing sunbeam, stealing in to cheer the sickly prisoner in its dark cellar dungeon?

THE PLANT STEMS.

The trusted nurse and confidential friend of the plant household, as I have said, is the stem. Now, these stems are divided into two great classes: first, those who feel it necessary to chaperon, or matronize, their young charges on their entrance into the gay world; and second, those who feel it their duty, as prudent housekeepers, to stay below and take charge of the family stores.

As might be expected, these two classes are very different in personal appearance, character, and dress. The former, who,

as a rule, are always actively stretching themselves upward, lifting the leaves and flowers, are usually rather slender, very ambitious, and dress in pretty light-greens or olive-browns. The latter, on the other hand, who, with few exceptions, do little moving about, settle themselves down in one place, grow fat and jolly, and usually wear plain brown dresses something like the roots. Indeed, you would be very likely to mistake some of them for roots if you should see them. Mrs. Crocus **Corm** and Madam Lily **Bulb** would never have their positions mistaken, it is true; but it would be very natural to suppose Dame Potato **Tuber** and Goody Sweet Flag **Rhizoma** to be roots.

The housekeeper stem, after seeing that her charges are properly dressed for their entrance into society, gives them a little affectionate parting tap, tells them it is time to go, promises to send up their meals, and then settles back to her other duties. Oftentimes there are pale little flower buds below who are not allowed by their older sisters, dancing up there on their sunny balcony, to join them, and then the motherly old nurse must pet



Fig. 4.

Scale-covered bulb stem of Lily. *bl*, Nurse Stem herself; *sc*, the leaf-like scales forming her dress; *l*, the sessile leaf servants; *gr* represents the ground line.

and comfort the poor things, who are thus condemned to blossom in the darkness, unseen.

Sometimes, indignant at the heartlessness of the older flowers, the other stem will seize some of these little buds, with their attendant leaves, and creep silently along the ground, until she



Fig. 5.

Strawberry Plant, showing the little households to whom the running stem has given a chance for homes of their own.

is at a safe distance from their tyrannical sisters. Setting down one group of leaves, and bidding them take good care of their helpless mistress, she hurries on to do the same for another group; and, if the servants do their duty, new and independent plant households, like the first, will soon be formed. Look at the Cinquefoil or the Strawberry Vine, and see how many little buds must thus have been saved from a gloomy life in the dark earth below.

The fleshy, prostrate, underground stem of plants like the Sweet Flag, Solomon's Seal, and Blood Root, that live on for a number of years, is known as a **Rhizoma**. It is less contented than most of the underground stems; and, being unwilling to spend its entire life in one place, moves slowly on from year to year, bearing the plant with it. If you should search in the ground for one of these stems, you would find it moving along in

a horizontal direction, not very far below the surface, and rooting itself firmly at every step. Unless the plant should be very young, you would probably find the stem made up of several distinct joints; and if you were looking at that of the Solomon's Seal, you would see the curious, seal-like scars on each joint, from which the plant has received its name. And when you look at these scars, you are seeing the very places where, in different years, the plant has had its home; and you can tell from them just how far, from year to year, the restless stem has carried her dependent little household.

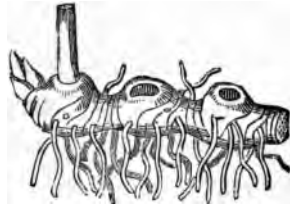


Fig. 6.

Rootstock or Rhizoma of Solomon's Seal.

A few words about the leaves here in connection with the underground stem. Of course, those leaves that are sent directly from the ground, instead of being lifted up in the arms of the stem, must either have longer footstalks, or, if sessile, like those of the Lily in Fig. 4, they must, as a rule, be taller than the friends who cannot be trusted to go up alone.

Some of the stems accompanying their young charges into the outer world do this from a real sense of duty, although they are not even able to stand upright, but have to depend upon wooden crutches for their support. One of these, the Morning Glory Vine, is a noted character. In some ancient quarrel between herself and the Hop, the sun came to the help of the latter. So bitterly did the Morning Glory resent this interference, that she would never again accompany him in his daily walk, but would

pettishly turn herself in the opposite direction whenever she saw him coming; and to this day the obstinate flower still persists in winding from right to left — against the sun — instead of from left to right, as is still done by the grateful Hop.



Fig. 7.

Compound leaf and tendrils of the Pea.

A few very slender, weak stems of the matronizing class, like those of the Grape Vine and Virginia Creeper, are provided with long, delicate hands, called **Tendrils**, with which they seize hold of some support and lift themselves upward. The Pea and Vetch are tenderly assisted by their loving leaves, to whom, instead of themselves, have been given these tendril hands. The leaves of the Clematis, as also those of the Mountain Fringe, uphold their trembling vines by coiling their own foot-stalks around some firm support; while with the Green-brier, the stipules of the leaves

are only too happy to be allowed to perform the same helpful office for their kind old nurse.

THE CARNIVOROUS PLANTS.

Now that you know by what a retinue of servants the flower is always surrounded, and what she expects to be done by each one, I think you are ready to hear about some singular plants of ours, the leaves of which have a curious, and certainly a very unpleasant, duty to perform.

The Venus's Fly Trap of North Carolina, as well as the more common Sundew and Pitcher Plant that grow in our low, boggy places, are flesh-eating households. They are not at all contented with the ordinary food of plants, but make frequent demands for a rich meat soup in addition. Now, since no one can, or will, supply the savage flowers with the necessary meat for this purpose, the plants, in the most cold-blooded manner, set about luring in the passing insects to satisfy their fierce appetites.

Since the work of preparing the meals is done by the leaves, it is upon these servants that the whole burden of decoying the unsuspecting insect to his untimely death must fall. Let us turn from the cruel flower mistress, who, after all, is responsible for the deed, and watch the leaf as it prepares to carry out her will.

Here is the leaf of the Venus's Fly Trap. See how strong its broad petiole-like part is! Look at those sharp spines, like slender teeth, along the edges of the roundish upper portion of the leaf. What do you suppose they are for? And what do you think those harmless-looking hairs scattered over the leaf, between these rows of teeth, can have to do with catching flies? Ah, here comes an insect wandering by! Perhaps he will show us.

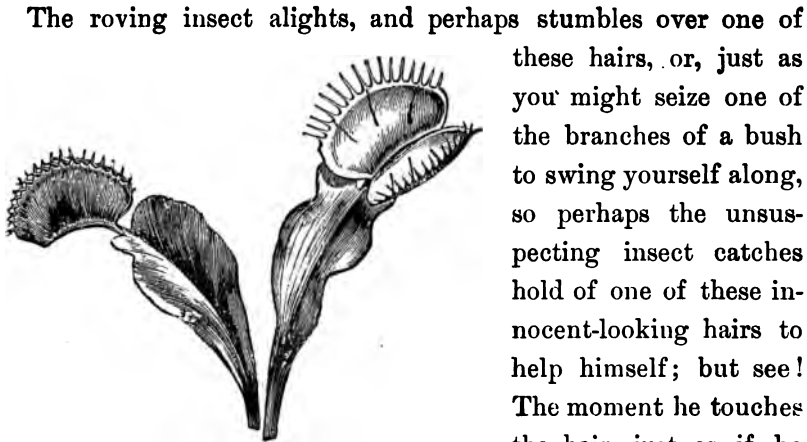


Fig. 8.

Two of the spine-toothed leaves of the Venus's Fly Trap; the one on the right shows the sensitive hairs, which, being touched, cause the closing of the leaf and the interlocking of the spines, as seen in the leaf on the left.

spines interlock above their victim; and the unfortunate insect is swallowed up from sight — forever.

* * * * *

What do you think is now going on within the silence of those closed walls? I will tell you. Everywhere from openings on the surface of the leaf, is being poured out a liquid in which the dead body of the insect may already be beginning to dissolve. When he shall have entirely disappeared, the demands of the plant household will have been satisfied, for their insect soup will have been prepared and carried far within the leaf.

The leaf of the Sundew acts in an equally treacherous manner. It is covered with hairs, or spines, the ends of which are tipped with

these hairs, or, just as you might seize one of the branches of a bush to swing yourself along, so perhaps the unsuspecting insect catches hold of one of these innocent-looking hairs to help himself; but see! The moment he touches the hair, just as if he had loosened the springs of a steel trap, the two sides of the leaf snap together; the teeth-like

a very sticky, but clear liquid, shining like dew in the sunlight. When the insect alights, he is held fast in this sticky mass, from which he is unable to free himself. Struggling to escape, to his horror he at length sees the other hairs slowly closing over him, one by one, and forming an impassable lattice-work above his head, while his body is still surrounded by this sticky fluid. Powerless to move longer, the miserable victim takes one last look through the open bars of his prison gate, and dies from sheer exhaustion and fright. A cup-shaped vessel has now been formed by the leaf, and the slow process of transforming the mass within to the required soup begins. But the whole process of attracting and killing the insect and preparing the soup is a much slower one than that used by the leaf of the Venus's Fly Trap, and it is usually three or four days before the soup is ready for the impatient flower.

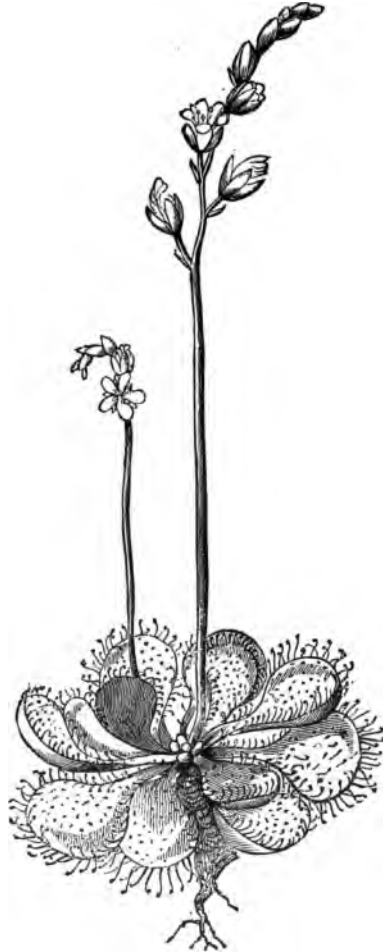


Fig. 9.

Leaf servants of Round-leaved Sundew.



Fig. 10.

Common Pitcher Plant and leaf servants.

The long, tube-like leaf of the Pitcher Plant, with its overhanging lid, acts in a very different, and perhaps a little less blood-thirsty, manner. Throughout the upper part of the leaf-tube are

numerous hairs, pointing downward, that are hardly noticed by the insect visitor as he enters. Once past these hairs, however, he finds himself sliding with frightful speed down the slippery side of the leaf and into the water standing in its hollowed-out base. He is really fortunate if he is drowned at once; for even should the doomed insect escape an immediate death and slowly struggle back up the steep side, down which he so lately slid, it is only to find those unnoticed hairs now presenting an impassable barrier in his path. He sees that there is no escape from those cruel waters, and, sooner or later, he must loosen his grasp in despair and fall back into the waiting death below.



THE FLOWER HOUSEHOLD INCLUDES

1. The Flower Mistress.
2. The Leaf Servants.
3. The Stem Servants.
4. The Root Servants.

DUTIES OF

- | | | |
|-----------------------|---|--|
| 1. The Leaf Servants: | { | (1) To eat and drink for their Mistress.
(2) To aid in her breathing and digestion.
(3) Sometimes to protect her. |
| 2. The Stem Servants: | { | (1) To uphold the Flower Mistress and the Leaves.
(2) To aid in distributing the Crude and Prepared Sap. |
| 3. The Root Servants: | { | (1) To bring water and food materials for the household.
(2) To hold the Flower home in place.
(3) Sometimes to help the Flower in climbing. |

Bracts (flower): small, leaf-like parts near the flower.

Bulb: fleshy, scale-covered stem of Lily, Onion, etc.

Compound Leaf: page 16.

Corm: solid, fleshy, bulb-shaped stem of Crocus, etc.

Leaflet: one of divisions of compound leaf.

Petiole: footstalk of leaf.

Rhizoma: fleshy, prostrate, underground and rooting stem of Sweet Flag, Solomon's Seal, etc.

Sap: page 19.

Sessile: sitting, not stalked.

Stipules: leaf-like appendages at base of some kinds of leaves.

Stomata: tiny openings—or breathing mouths—of plants, found on green surfaces of parts exposed to the air.

Tendrils: thread-like, coiling appendages by which certain plants are aided in climbing.

Tuber: thick portion or branch of underground stem, having "eyes" like the potato.

CHAPTER III.

THE FLOWER MISTRESS AND HER SEEDS.

WHEN, according to long-established custom, the time has arrived for the little flower to take her first look at the world, she is closely wrapped up in a thick green mantle, and either carried out on her airy balcony in the arms of her faithful nurse or sent out upon a long, slender footstalk, known as the **Peduncle**.

Very timid is the flower bud at first. You would never dream that this shy little creature, hiding even her head in the folds of her mantle, could become the imperious blossom that is soon to bring the whole household under her sway. But the change is coming, and very quickly.

Encouraged by the gentle whisperings of her foster-brothers and sisters, and by the tender words of her motherly old nurse; gayly called by every passing bird and bee; coaxed by the dancing sunbeams; wooed on every side by low, mysterious promises of happiness to come; she at length peers out timidly from beneath her friendly covering, and, growing fearless under the warm kisses of the sun, soon throws back her mantle and stands forth proudly—a little princess in her royal robes.

This mantle, enveloping the entire bud in its shining folds, is usually green, and is called the **Calyx**, from a Latin word meaning

cup. If you will look closely at any little flower bud before it has dared to take its first peep into the world, you will at once see why its cup-like mantle should receive this name of *calyx*.

Some of the flowers seem to think that in so short a visit to the world as theirs, an extra set of robes is unnecessary, and therefore all the rich embroidery and gorgeous coloring — which would otherwise fall to the share of the inner one — is lavished upon this outside mantle, which thus at once gayly proclaims the rank of its little mistress.

When, however, the flower bud has preferred green for her mantle, you may nearly always look for some charming costume beneath, all the more pleasing from its marked contrast to the modest calyx. And when the little bud, clothed in her dainty robes, begins to throw back the great green points of her mantle from about her shoulders, and, blushing and dimpling with the consciousness of her own loveliness, smiles coquettishly up at us, could there well be a lovelier sight, do you think?

The inner dress, which usually indicates the royalty of the flower, is called the **Corolla**, from a Latin word meaning a *little crown*. Sometimes it is all in one piece, but more often it is formed of distinct, leaf-like parts called **Petals**. It is usually much more delicate in coloring and texture than the calyx, though in some flowers, like the Tulips and the Lilies, it seems to be made from exactly the same material as the mantle, which, in these plants, is usually of some color other than green.

The dainty casket containing her precious seeds is carried by the flower bud within the inmost folds of her robes, where it is closely shielded from any possible mishap. It is known as the

Pistil, and its shape varies greatly in different plants and families; but no matter how widely its forms may differ, two distinct parts, and usually three, are always to be found in it. The lowest, largest part, which contains the seeds, is the real seed casket or **Ovary**, and the little opening in the top of this, through which alone it is possible to gain access to the seeds before they have become ripened, is known as the **Stigma**. Sometimes the stigma opens directly into the ovary, but oftener it is placed at the end of a long, slender tube, called the **Style**, which leads down into the seed casket.

Some flowers value their seeds so highly that they will not crowd them all together into a single ovary, but insist upon having a separate one for each seed. The Buttercups and Anemones weigh themselves down with their heavy burden of separate little pistils, each with its one tiny seed. The Columbines, however, while still keeping their five caskets, each with a long row of seeds, quite distinct from one another, yet have these joined by their inner edges into one very easily carried cluster. The St. John's-worts and Lilies, on the other hand, adopt a much more space-saving method, and crush all the inner edges of the ovaries together in such a manner that, instead of three distinct ones, there appears to be one large seed casket divided into three compartments, such a one being known as a **Compound Ovary**. Of course, when the ovaries are thus crowded together, you will

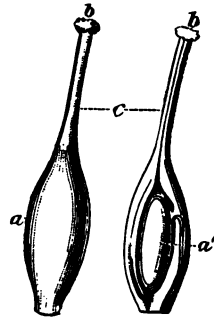


Fig. 11.

Simple pistil of the Plum, showing, *a*, the ovary, or real seed casket; *c*, the style; *b*, the stigma. The same pistil is seen in the second figure, cut through vertically and showing the use of the ovary.

expect to see the styles and stigmas also crowded to a greater or less degree. Sometimes there will seem to be but one stigma or style for the whole compound ovary, and then again, there may be no styles at all, but a number of openings, or stigmas, instead, each leading directly into the ovary; and by looking closely at



Fig. 12.

Compound ovary of Lily, cut across to show how the three original ovaries have been combined into one seed casket.

these styles or stigmas, you can almost always tell exactly how many pistils the flower originally carried.

The great work of the flower, as I told you awhile ago, is to bear the seeds from which new plants are to spring. This means, of course, that she must keep them safely guarded until they have become *fertilized*, or *made capable of growing up into new plants*. Now it is a fact that it is absolutely impossible for one of these seeds to become thus fertilized, unless a peculiar yellow powder known as **Pollen** is given to it, and consequently, nearly every flower carries a great quantity of this pollen powder just outside of its seed casket. Not a single bit, however, can she give to the seeds herself, even though one tiny grain may be all that is needed. Her root, stem, and leaf servants are as helpless as she; yet the seeds must be fed, and there are no other servants upon whom to call for aid. Now what do you think the flower does? I am sure you never would guess; so I must tell you. By all sorts of pretty, coaxing ways, by any means — fair or unfair — she appeals to every passer-by for help. The wind, the bee, even the smallest insect, is not despised, and, wily little strategist that she is, Mistress Flower usually succeeds in getting her wishes

accomplished. Tempting the bird or bee with her fragrant breath and sunny smile; now offering honey to this one and that; here, artfully flattering the sober moth; there, fascinating some roving butterfly or beetle by the brilliancy of a gorgeous costume; she coaxes them, one and all, to own her power and do her royal bidding. Perhaps some little insect, less easily won over than his comrades, may show signs of attempting to escape from her wiles. Watch her closely. Sometimes she shows an unexpected cruelty, and lures the poor victim on by her caresses into sudden ambush, whence there is no escape until he has agreed to carry the pollen to the waiting seeds.

Gather a Tiger Lily, or any one of the great yellow or red lilies that blaze out in our fields and on our hill-sides during the summer months. Why are you so careful to keep it at a distance from your face? "Oh, that queer yellow powder comes off," you say. Now let me tell you that this same "queer yellow powder" is the very pollen dust without which no seed can be fertilized. You see it very easily here because the flower is so large; but no matter how small the blossom may be, it usually carries a large quantity of this fine yellow powder along with its seeds.

Shall I tell you *how* the flower carries this same powder, before I tell you something very curious in regard to the whole matter of its being carried at all?

Standing just outside the pistil or pistils in most of the flowers, you will usually find a row of slender, thread-like little stalks, each bearing a soft oblong body at the top, out of which you will often see this pollen falling, either in a fine, feathery powder, or in distinct, rounded masses. The thread-like part is called the

Filament, from a Latin word meaning *thread*. The soft little body containing the pollen is the **Anther**, while the whole thing — filament and anther combined — is known as the **Stamen**. By examining the anther through a microscope, or looking at one on some very large flower, like any of the lilies before mentioned, you will see that it is made up of two hollow parts, lying side by side, and joined together by what often seems to be the upper part of

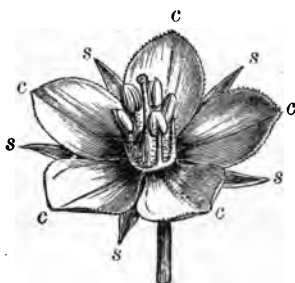


Fig. 13.

Scarlet Pimpernel, or Poor Man's Weather-glass. *s*, calyx points; *c*, fringed petals of corolla: within these is seen the seed-casket or pistil, surrounded by the five stamens with their hairy filaments and large anthers.

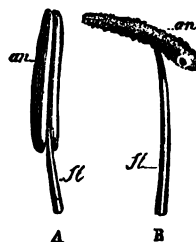


Fig. 14.

Stamens of wild Turk's-cap Lily. In *A* the anther is just beginning to open; while in *B* it has opened, and is now seen covered with its pollen.

the filament, though it is considered of enough importance to have a name to itself. Each little lobe in which the pollen is carried usually has a seam running lengthwise down its face, out of which, when ready for distribution, fall the yellow grains of pollen. Sometimes, however, the lobes open through a little chink, usually at the top, which may, or may not, be protected by a tiny lid that opens upward when it is time for the pollen to be sent out.

The positions of the anther on the filament may differ a great deal; sometimes being joined throughout its whole length to the entire upper part of the filament; sometimes attached to one side only; and then again connected with the filament simply by one point in its back. Its lobes may open inward, toward the pistil, so that the pollen may easily fall upon the stigma, or they may open outward, toward the corolla. Whatever may be its situation or manner of opening, however, its one great use, as I have already told you, is to carry the pollen so necessary for the seeds.

The number of stamens carried by some of the flowers is really quite wonderful. Sometimes there are so many that it seems almost impossible to count them. On the other hand, many carry only two, and some, only one. Oftentimes a flower will make a great display with her stamens, and, after all, when you examine them, you may find either some with no anthers at all, or half of the anthers empty. There is a very good reason for this, however, since if the flower is perfectly sure of getting some of the pollen to the seeds, she does not need to carry very much; while if there is any doubt in the matter, and she is obliged to trust entirely to outside help, she must carry a great quantity in order to be sure that even a little may fall where it is needed — upon the stigma.

Do you remember that I was to tell you a very curious fact connected with the carrying of this pollen powder? Listen, now. Notwithstanding the fact that the flower must have pollen for its seeds, and that she usually carries great quantities of this same powder within her own anthers, *she very seldom carries any that will fertilize her own seeds*. Doesn't this seem very strange to you?

Let us see now how this problem of getting the right kind of pollen to the right seeds works itself out ; but first, let me tell you of two classes of plant households in which the work of bearing the seeds and carrying their necessary food is divided among the flowers, some bearing only the pistils, others, only the stamens, but no one flower ever bearing both pistils and stamens. One set of these, known as **Monœcious**, to which belong the Oak, Beech, and Chestnut, is very independent, since the carrying of both seeds and pollen for one plant is done by its own flowers.

Our common Green Corn is a monœcious plant, the pretty, brownish-gray tassel at the summit of the stem being made up of the stamen-bearing flowers, while the *pistillate* blossoms (those having only pistils) are borne far below on what is known as the "cob," their ripened fruit forming later the sweet kernels of the "ear." Now, remembering that the *staminate* flowers (those having stamens only) are above, what do you suppose the heavy yellow silken strands, drooping beyond the protecting husk of the ear, are? Why, they are the *long, slender styles of the pistils*, of course.

One thing I must tell you, however, and that is, that the pistillate flowers of this plant are usually so overhung by the broad green corn leaves, that they are seldom able to get any of the pollen from the staminate flowers above on their own plant, but are more likely to receive it, brought by the wind from some of their nearest neighbors.

The other class of these peculiar plant households, which produce separate pistillate and staminate flowers, is known as **Dioecious**, and to them belong plants like the Greenbrier and the

Meadow Rue. These cannot go off and settle down by themselves, but are dependent upon one another, since for every fertilized pistil two separate plants are necessary; for upon one plant every flower will bear the seeds alone, and thereby every flower upon its nearest kin is compelled to furnish the corresponding pollen.

In some flowers the pollen is ready to be given out long before the young seeds are ready to receive it; while in others, the seeds may be anxiously waiting for the food which is not as yet prepared for them. In the former case, the seeds of the flower whose pollen food is still unprepared, by the help of a friendly breeze seizes eagerly upon that of its neighbor. The sluggish seeds of the latter must then pay the penalty for their tardiness, by waiting for the slow-ripening pollen grains of their more active rivals.

The English "Cuckoo-pint," a plant looking very much like our own "Jack-in-the-pulpit," but having its flowers differently arranged, is one of the plants whose pistils ripen before the stamens; but since all the flowers are so closely enveloped in a great sheath-like leaf, or **Spathe**, that the wind cannot be of any help, the plant must find some way of impressing the passing



Fig. 15.
The English Cuckoo-pint.
Spathe closed.

insects into its service. A very artful plan is therefore adopted, which works to perfection. On the lower part of a thick, club-shaped stem, whose long purple summit we Americans should call

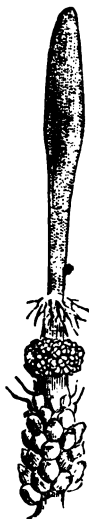


Fig. 16.

English Cuckoo-pint.
"Master Jack" taken
out from the spathe,
and the general ar-
rangement of the
bristles and the stam-
inate and pistillate
flowers shown.

"Master Jack," are borne separately the two kinds of flowers—the staminate first, and below these, the pistillate. Just above the flowers are some very stiff bristles that can easily be pressed downward by any entering insect. Once safely in, however, the luckless victim finds himself fairly entrapped; for the bristles, which yielded so easily on his entrance, now stand out, stiff and unyielding, and bar all attempts at escape.

When he enters, the pistils are ripe, and the seeds are waiting for their food. The anthers, however, are not yet ready, and relentless Jack, determined to keep his victim within until some pollen shall be ready to be carried away to a neighboring plant, smiles grimly to himself as he hears the poor little fellow running round and round below, knocking against his prison walls, or beating himself against the stiff bristles over his head. By and by, the pollen is ready, and the fine, powdery dust fills the whole space, nearly choking the unhappy victim, who, in his frantic attempts at escape, gets himself completely covered with the yellow dust. Jack's purpose is accomplished. Though too late for his own seeds, yet some of the pollen will surely be carried away to his

neighbor, and, with a malicious smile, he now draws back his warlike bristles. Up comes the little prisoner, almost blinded, and staggering under his yellow burden; but he has learned nothing from experience, for perhaps the very next Jack with whom he meets may lure him down to taste some honey prepared for him below. Here again only the pistillate flowers with their seeds are ready for him. Now comes the moment of triumph for the first Jack. In the eager haste of the insect to sip the sweet drop from the lips of the tiny flower bending to receive him, he rudely brushes her with his clumsy wings or body, and behold! some of the pollen has fallen upon the stigma, and the happy flower laughs with joy as it sees the precious grain within reach of the waiting seed.

Do you know the pretty "Bluets," or "Innocents," that grow so abundantly in our fields and upon our sunny hill-sides during the early summer months? Each little flower carries both pistils and stamens, it is true; but it is not for its own seeds that it carries the powder. No indeed! There is a friendly law of give and exchange among these sociable little flowers. Each one carries the pollen for its neighbor's seeds, and, with the heartiest good will, sends it out at the very earliest possible moment. Some carry a short pistil with anthers borne above, while others bear a long one, the anthers being carried far below.

Each kind, settling down by themselves in neighborhoods of fifties and hundreds, smile in the most winning manner upon their gallant insect friends, for whom they always keep a store of luscious honey, well knowing that this is the most tempting dish which can be offered them.

Allured, both by the smile and the dainty morsel, the insect visits his charming friend, perhaps at just the moment when the pollen is ripe and the wily flower is manœuvring to have it carried to her neighbor. It may happen to be a Bluet with the long pistil and *low anthers*, upon whom he calls. If so, by her kisses and embraces, she keeps him at her side until even his mouth is smeared with the golden pollen. Tired of her caresses at last, and perhaps having eaten all her honey, the gay rover seeks the fresher charms and newer honey of her neighbor, and, quite unconsciously, thus carries out the will of Madam Bluet, who smiles to herself as she notices the direction he takes. Perhaps he now visits a Bluet whose anthers stand *above* the pistil. Taking no notice of these anthers, which are probably not yet ready to open, he hurries down to taste the sweet honey offered him, but, as he eagerly presses his mouth, still smeared with pollen from the low anthers of the first Bluet, see! some of the yellow powder is left upon the stigma—and both Bluets are happy. Again the fickle wanderer seeks a fresh supply of honey; but as he goes out into the air, past the now opened anthers, he can scarcely avoid carrying away with him a large quantity of the yellow dust from these anthers to the third flower. If she happens to be one of the *long-styled* Bluets, her seeds are probably ready and waiting for their food—and then there will be three happy Bluets in this neighborhood.

With the Mountain Laurel and the common Tape or Eel Grass, that we often find so great an annoyance in our slow waters, the responsibility of seeing that the seeds are fertilized rests upon the elastic filaments of the stamens, or upon the slender, coiling stalk *of the pistillate flower*.

In the Laurel, the pistils and stamens are borne by the same flower. The filaments of the latter are very elastic and, if pressed upon by any outside force, will spring up so suddenly that the anthers, resting in depressions of the corolla, will be drawn up violently against the pistil, breaking and discharging their contents far and wide, — perhaps far enough to send the pollen upon the stigmas of some neighboring flower.

The Tape or Eel Grass, with its underground stem, is dioecious. That means, you remember, that the pistillate and staminate flowers are borne upon different plants. The pistillate flowers are carried by very long, elastic flower stalks — sometimes from two to four feet in length — to the surface of the water, where they lie waiting for the needed pollen. The very minute staminate flowers are without peduncles, being closely sessile on a thick stalk, known as a *Scape*, down in the muddy bottom of the water, where of course it is impossible even to see their neighbors. Now notice the plan adopted in this case. While still in the bud, the whole staminate flower breaks away from the scape, and rising through the water, opens the moment it reaches the surface. The anthers then bursting open discharge their pollen grains, which float about until seized upon by some of the pistillate flowers lying in wait for them. The thread-like flower stalk of the latter, having carried the blossom to a place whence the pollen could be reached, now slowly, and very gradually, coils itself up spirally and carries the seeds, with their food, back under the water, where they may be matured undisturbed.

Having learned how necessary the pollen is for the fertilization of the seeds, and by what wily manœuvring it is finally brought

within their reach, let us turn now to look at the seeds themselves,—those promises left behind by the departing flower, that blossoms like her own shall again visit our sunny fields and shadowy woods.

Take the seed of a Morning Glory. What do you suppose there is inside of it? Let us soak it in warm water for a little while, and then cut it open and see what we can find. Within this seed, closely surrounded by a solid white substance, I can see a little wrinkled mass that looks as if it might possibly be formed of some very minute, folded leaves. Do you suppose they really can be tiny flower leaves sleeping here in the darkness? But if so, where is the bud whose servants they are? And where are their fellow-laborers, the stem and the roots?

Look closer still—through a microscope, if you have one. Now tell me—do you not see something like a tiny root extending downward from these baby leaves, that we will call **Cotyledons**? And between these cotyledons, if you look very closely, can you not see a little rounded projection, looking perhaps like the beginning of a stem? They are all there,—all that are necessary for the beginning of a plant household,—the tiny point like a root, known as the **Radicle**, the leaves or **Cotyledons**, the stem—the **Plumule**—bearing an unseen flower bud; and all this solid white matter that you see *is food packed away for the use of the plant when it awakes.*

Here is a much larger seed,—that of the common Bean. Let us cut into this one also. Ah! there are the radicle and plumule, but where are the cotyledons? Are you looking for the baby leaves *within* those fleshy white masses, which you probably think

to be the stored-up food for the young plant? If so, you will not find them, for the very good reason that *these thick white bodies are the leaf servants, or cotyledons*. In this case, the prepared food for the new household is packed away within the cotyledons themselves, every cell being filled, even to overflowing, with a sweet substance used for food, not only by the plant, but by the human household as well.

So here, within these seeds, an abundant store of food close at hand, are two little plant households, each with its root, its leaves, its stem, its mistress; but all are motionless, wrapped in sleep. And fast asleep in her enchanted palace will remain the little princess bud and her servants for many a long month and year, unless the fairy prince shall come, stealing through light and darkness, to press the expected kiss upon her waiting lips.

Lay some seeds — the Morning Glory, a few kernels of Corn, some Beans, or Peas — within a thin layer of cotton, protected from the sunlight. Keep them moist and at a moderately warm temperature, and you will soon see for yourself the charm broken and the whole household waking from its long sleep. Better still; in the spring, plant your flower seeds in some warm, moist soil, but not too far from the air, through which is to come, invisible, the fairy prince with his awakening kiss.

The drowsy little bud wakes only to sleep and dream again; but the enchanted sleep once broken, the whole household is astir.

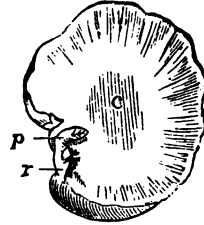


Fig. 17.

Bean seed cut through lengthwise and showing, *c*, one of the cotyledons; *p*, the plumule, or tiny stem; *r*, the little root, or radicle.

The sweet, starchy food packed either around or within the cotyledons is ready for the plant on its awakening, and very

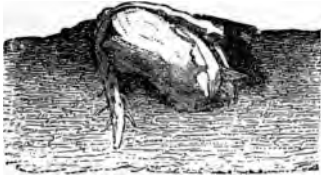


Fig. 18.

The little Bean household aroused from sleep and at work.

soon the leaves, the stem, the root, are strong enough to begin their work. Downward goes the tiny radicle to lay, deep and firm, the beginning of the foundations for the home; upward climbs the little stem, bearing her precious charge, still invisible; new leaves unfold them-

selves. All are actively at work; and in the early summer time, amidst the twittering of happy birds and the tremulous sense of awakening life in the air, a new plant takes its place upon the earth to gladden eyes and hearts wearied with the long, cold winter of our Northern clime.



Anther: soft, oblong, pollen-bearing body on summit of stamen.

Calyx: outer, leaf-like covering of flower.

Compound Ovary: page 35.

Corolla: inner, leaf-like covering of flower.

Cotyledons: leaves of minute plantlet *within the seed*.

Dioecious: staminate and pistillate flowers borne upon different plants.

Fertilization: page 36.

Filament: thread-like stalk of stamen, upon which is borne the anther.

Monocious: staminate and pistillate flowers borne upon the same plant.

Ovary: that part of pistil in which the seeds are borne.

Peduncle: flower stalk.

Petals: leaf-like parts of corolla.

Pistil : whole seed-bearing part of flower.

Plumule : tiny stem of minute plantlet *within the seed*.

Pollen : fine powder or grain necessary for fertilization of seed.

Radicle : the tiny point — something like a root — of minute plant *within the seed*.

Scape : thick flower stalk arising from an underground stem.

Spathe : sheathing, leaf-like part enveloping collections of flowers, as in Calla, Jack-in-the-pulpit, etc.

Stamen : thread-like part of flower, bearing the anther at its summit, and itself borne just outside the pistil.

Stigma : opening in pistil, through which alone the pollen reaches the seed.

Style : slender part of pistil connecting stigma with ovary.

CHAPTER IV.

THE COMPOSITES AND GRASSES.

YOU all know the little Field Daisies that smile up at the farmer from out his grains and grasses as cheerfully as if they were his best friends, instead of being, as they really are, among his worst enemies. And who does not know the happy Dandelion, "fringing the dusty road with harmless gold"; the gay little Asters, nodding merrily at us from every wayside tangle and neglected hill-slope; or the yellow Golden Rod, proudly waving its gorgeous banners in the path of approaching autumn?

But I wonder how many of you know, also, that what we call a flower is *not a flower at all*. Take one of these so-called blossoms—a Daisy, perhaps—and pull it to pieces. Do you think that all these separate little parts are flower petals? Look closely at the yellow ones that were in the centre. Do you not see that these are all tiny, tube-shaped flowers, each having its own minute set of stigmas and anthers? Look now at the white, petal-like parts that formed the outer circle of what we called the blossom, and you will see that these, also, are little flowers, though differing from the others in the color and in the curious strap shape of the corolla. *A collection of tiny, stemless blossoms, crowded side by side upon the rounded, platform-like top of the flower stalk, and thus forming one dense Head*,—this is the real

nature of what we know as the Daisy, the Everlasting, the Wild Sunflower, the Thistle, and the Dandelion. But in some of these, as the Thistle and the Dandelion, you will find that all the blossoms in the same head are alike, while in the Daisy, as we have seen, there are two distinct kinds. The reason for this great difference you could never guess, I know. Listen, then.

Once upon a time, long, long before the great human giants took possession of Elf and Fairy-lands, and crowded out their helpless little people, every river and stream, plant and tree, sunny hill-side and shadowy wood, was a home for the tiny fairy-folk. Brown little wood-gnomes, helpful brownies, mischief-loving elves, and gay little flower fairies made up the happy fairy world. Into its peaceful loveliness there came the heavy foot of man, bringing havoc and destruction in its path. At once the terrified gnomes fled deep down into the earth, and nothing has ever been seen or heard of them since that time. The elves retreated far within the rocks and shades of Elf-land, and we shall see what became of them, later on. The brownies, helpful and fearless, tried to make friends of these giants, but in vain, and they, too, at last were forced to seek for refuge from the trampling foot of man.

First of all the fairy-folk to be crowded out of their homes were the sun-loving flower fairies. The warm, cheerful places so much loved by them were liked by man as well, and where that bustling giant chose to make his home, there was no longer any happiness to be found by the shy little flower fairies. But what could they do? Bid farewell to twittering bird, to merry brook,

to dancing sunbeam? Turn from the warm brightness of this upper world to the cold darkness below? Exchange this cheerful, happy life they loved for one of silent gloom? No. It was too great a sacrifice; and with mournful sadness, the fairies laid down that great right which had always been theirs — the right to live forever — and, no longer as flower fairies, but as *flowers themselves*, they remained upon the earth and in the midst of their once-dreaded foes. But the fairy nature was gone, and in the dainty flower mistress of to-day, all that remains to remind us of the old-time fairy, is the happy smile with which she turns to greet the approaching sun.

In those old fairy days, while as yet the flowers were only *fairy homes*, they were much larger than now. Some of them, indeed, were so large that, safely enclosed within their fragrant petals, whole groups of tiniest fairies were wont to pass the merry days in song and dance; so then when, as flowers, the changed fairies looked out again upon this world, it was not strange that, from among their happy comrades, a new kind of flower should now smile gayly up into the wondering eyes of man.

Wherever there had been a fairy *group*, there now clung close together a collection of tiniest blossoms. So tiny and so close were they, that it was long, long before man discovered what they really were, and even to this day I suppose that there are many people who still think these collections of minute flowers to be only one simple blossom.

But we know better than this, now. And we know, too, that when we speak of the Daisy, the Dandelion, the Thistle, the Aster, we are thinking of them as *names* of *collections* of *tiny*

flowers, just as when we speak of a *school*, we are thinking of it as the name of a *collection* of boys and girls.

Botanists know this family of flowers as the **Composites** (or Compound Flowers). They are among the largest, as well as most interesting, of all the flower families, and while, as a rule, perhaps the wild ones are not as pretty as some of those with single flowers, yet the unselfish, sweet-tempered little blossoms, or **Florets**, of the Composites, form the happiest, busiest, and most united of all the flower households. They live on the most friendly, helpful terms with one another. Where there was any difference of size in the original fairy group, you will find that all the smaller, more delicate florets of the Composites are in the centre, closely guarded by a sentinel-like circle of their larger, and usually sturdier, companions.

Now you know why, in the Composite family, some of the heads have two kinds of florets, while others have only one. And we shall see, a little later on, that where two distinct kinds are thus found upon the same head, there is a friendly exchange of kindnesses between the two, — that while the sentinel flowers are helping and protecting their smaller companions, the latter, in their turn, are usually carrying pollen enough for the seeds of their larger friends, and sometimes, as in the case of the Sunflower and Mayweed, these sentinels are excused even from carrying the seeds.

Let us see now how these *floret* households of the Composite family differ from the *flower* households that we have already learned to know.

Root servants, stem servants, leaf servants! Yes, all there.

But there is only one stem for the whole head of florets, and the leaf servants are never allowed to have any foot pages (stipules). I think this must be because the florets are such industrious little beings themselves, that they are not willing to place the least

possible temptation to idleness in the way of their big foster-brothers and sisters.



Fig. 19.
Ox-eye Daisy.

Look now at the outside of what is called a Daisy "bud." Do you not find several rows of closely overlapping, leaf-like *bracts* enveloping the young household, just as in the other flower families we found the calyx cup enveloping the tiny princess bud in its folds? This whorl of overlapping bracts, performing for the whole head of florets just the same office that the calyx does for bud and blossom, is known as the **Involucre**. Its bracts are usually green, like the leaves, though often they are quite white and scale-like.

Smaller bracts, or scales, are often found among the florets themselves, but these little attendants of the Composite flowers, known as **Chaff**, are usually rather less to be depended upon than the faithful little bractlet friends of the flowers of other families.

Every floret has, of course, its own little calyx; but since the whole head is thoroughly protected by the involucre, the floret calyx is not needed for its ordinary use. Instead, then, of simply protecting the bud, it is drawn close over the seed casket, and we shall see, by and by, what an invaluable aid it is to the little

floret mistress when she is ready to send abroad her precious seed.

As we have seen, the two kinds of florets on the same head may differ greatly in the form and color of their corolla robes. In the Daisy household, we found the small centre florets all having yellow, tube-shaped corollas, while their sentinel friends were arrayed in much more conspicuous white, strap or ray-shaped robes; and this difference in the shape and color of their corollas is nearly always to be found where there is a marked difference in the size of the florets themselves.

There is something very peculiar about the stamens of the Composite households. The anthers are always united nearly throughout their entire length into *a little tube* closely surrounding the pistil. But, though they always discharge their pollen *inside of this tiny cylinder*, so that you would naturally suppose that some of it must pass through the stigma into the ovary, yet this is never known to happen.

Let us see, now, how it is that with the anther tubes thus discharging their pollen directly upon the enclosed pistil, the floret seed never receives any from the anthers of its own mistress, but must always depend upon having it brought from the anthers of another floret. You will say, of course, "Why, the stigma cannot be open, or the pollen would pass through!" Well, that is true; but this brings up another question: How does this pollen, always falling inside of the anther tube upon the pistil, ever get outside to fertilize any other seed?

To answer this, I must tell you, in the first place, that in the seed caskets of the Composite household, only one seed is ever

carried at a time. A little one-celled, one-seeded ovary, with a slender style, having a two-branched stigma at its summit, make up the floret pistil. But on this style is to be found something that we have never seen on a seed casket before, — a number of little hairs pointing upward. Sometimes these are on the tips of the stigmas, sometimes just below them, and sometimes, as in the Daisy florets, they are scattered along the style. What do you suppose these hairs are for? And what do you think they are called? When I tell you that they are known as “sweeping” or “collecting hairs,” do you not begin to suspect that they must have something to do with getting the pollen outside the anther tube? That is exactly their use; and if you have ever used a “bottle-brush,” you know just how these little hairs work.

Suppose, now, the anthers of the Daisy floret to be open and discharging their pollen within the tube, upon the closed stigma of the pistil. Little by little, the style grows longer, and, pushing its way up through the anther tube, collects upon its tiny hairs all the grains of pollen in its path, and sweeps them on through and out into the open air, where they lie, ready for wind or insect to carry them to waiting stigmas. For there are stigmas ready and waiting for them somewhere in the household, even though their own will remain fast closed until all the pollen has been carried away. When the floret mistress is sure that there is no longer any danger that one of her own pollen grains may find its way back down the seed casket, she allows the two branches or halves of the stigma to open and receive any pollen that may be brought from her neighbors. But do you not see, now, how much life and activity there must always be among the florets

on the same head? These two operations are continually going on at the same time. While some of the florets are having their pollen swept out in order that it may be carried to their neighbors' seeds, others, their pollen already disposed of, are now opening their stigmas to receive the food anxiously awaited by the seed below.

Of course, when her pollen is ready for distribution, we shall look to see the floret mistress putting forth every effort to allure the bees and smaller insects to her side. This is very easily done, however; for the florets of the Composites are greatly loved by all their insect friends, and the latter fairly throng the monster banquets which are continually offered them, and from which, doubtless, you yourself have often found some difficulty in shaking off the singing, honey-loving guests.

Bound by their common interests, all the florets of the Composite household combine to make a success of these great feasts. Where the centre florets are too small and too close together to attract more than the passing insect, the sentinel flowers take upon themselves the duty of inviting guests from afar. Arraying themselves in long robes of white, pink, blue, orange, or purple, they stand around the inner florets, who are perhaps meanwhile relieving them from the carrying of pollen or seeds, and wave joyous invitations to their far-off friends to attend the luscious feast prepared within.

Even if a sudden shower should disturb the merry banqueters before they have carried away the pollen grains, very little real harm is done, for the protecting sentinel flowers often draw themselves up quickly over their smaller friends, and then, safe within

their leafy shelter, the little florets wait patiently to greet again the sunshine and to welcome back their banished guests.

The floret mistress does not expect as much aid from the wind in carrying her pollen where she wishes it to go, as do the flowers of many other families. For one reason, she is too small herself, and bears her grains too closely guarded among the crowded florets, to attract his attention. But even if this were not so, and the whole group were showy and large enough to arrest the hurrying wanderer, yet she really would not care to impress the great, boisterous wind into her service. He is too big and rough. No matter how kind his intentions might be, he would be almost sure to sweep the pollen off far beyond the neighbors for whom it was intended. But a time does come when the strong wind can be of the greatest help to the tiny mistress, — a time when she does not hesitate to call in the aid of flying wind, of browsing cattle, of roving — **Man**. Yes, even you and I are made useful by Mistress Floret, and are compelled, unwillingly enough, to carry out her will and distribute her precious seeds.

If you wish to know how she does this, you will probably only need to look at your dress the very next time you come in from an autumn walk in fields or woods. Countless little "tickseeds" and many entire Burdock households will be ready with the answer.

When the florets of the Burdock are ready to dispose of their seeds, the *whole group* decides to emigrate and, drawing the stiff involucre close about them, stands ready to seize upon the first passing object with the sharp, hooked points of the bracts, — a method of whose final success, the fleece-covered sheep, the thick-

maned horses, and we ourselves, are only too often unwilling witnesses.

The method by which the floret mistress succeeds in getting wind, animal, and man to take charge of her seeds is a very curious one. I told you some time ago that, since the whole household was well protected by the involucre, the floret calyx was not needed for its ordinary use, but became an aid to the floret in the distribution of her seed. The tube-shaped calyx fits over the ovary so closely that even when perfectly dry, it is impossible to separate the two. Sometimes this tube-like part of the calyx seems to be cut off square above the seed. More often, however, the calyx extends above the tube into curious, spreading forms, called the **Pappus**. This pappus may take the forms of simple points, scales, plumes, or sharp teeth with backward-curving hooks.

Suppose, now, that the seed, with its ovary enclosed in the tight-fitting plummy, or sharp-hooked calyx-case, is ready to be sent abroad. To whom does the floret intrust her plume-decked seed, do you think? Or how, without this airy plume, could she ever hope to send away her tightly packed seed treasure? Watch

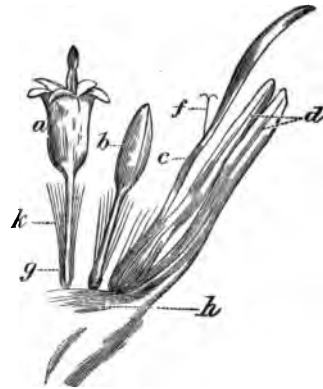


Fig. 20.

Greatly magnified view of three florets of common Colt's-foot: *a*, one of the tubular centre florets; *b*, bud; *c*, strap-shaped sentinel floret, without stamens, but with pistil, *f*; *d*, bracts of involucre; *g*, seed, surrounded by the calyx with its plummy pappus, *k*; *h*, the platform-like top of flower stalk upon which the florets stand.

the floating "down" of the Thistle, the feathery hands of the Dandelion "clock," the silky parasol — or parachute, rather — of the Vegetable Oyster. You will soon see who has become seed-carrier for the Thistles and the Dandelions; and the little "Tick-seed," firmly grasping your dress with the sharp, claw-like hooks of its calyx-case, also shows you very plainly whom else Mistress Floret has thought worthy to become her treasure bearer.

THE GRASSES.

The Grass family, with its countless grain-bearing households, is one of the largest of the flower families, and certainly is of the greatest use to man.

Though at first sight they look very different, yet the sober, quiet Grasses must have had the same origin as the gay, society-loving Composites, for the flowers of the Grass households also live in groups closely protected by bracted involucre. All that the Grass flower cares or lives for, however, is her seed. She cares neither for bright dress, nor gay company, and asks for no closer outside companionship than that of the passing wind. So great a dislike, even, have some of the Grasses for insect visitors, that they adopt a very effective method of defending themselves from these unwelcome intruders. Why do you suppose the Wheat and Barley arm themselves with their spear-like "beards" or "awns"? Or why, while the Summer Wheat must continually present a warlike front with her bristling spears, does the most of our eastern Winter Wheat find it entirely unnecessary to assume this defensive armor? Think a moment, and I am sure that you can



Fig. 21.

Barren Brome-grass: "a", spikelet.

tell me yourself why it is that the Summer Wheat is *bearded*, while that which is *sown in autumn* comes up *beardless*.

The stems are very different from those of other flower families. They are always jointed, and almost always hollow, except just at the somewhat swollen joints. Botanists know these Grass stems by the name of **Culms**, and from the fact of their being hollow, you can see that they are likely to be weaker than the stems of almost any of the other families.

The leaf servants are few in number, and are always very long, slender, and pointed. Instead of being supported by the stem, as is the usual custom, the leaves of the Grasses themselves help and support their friend and fellow-laborer, by wrapping their broad and flattened petioles about her in such a manner as to offer her a strong and sheath-like protection.

The flowers of the Grasses live together in groups, it is true, but their whole household, known as a **Spike** or **Panicle**, according as these groups are sessile or not, is not formed of one large side-by-side collection, as in the Composites, but rather of *a number of very small groups* called **Spikelets**, living in rows, one above the other. These small groups — or spikelets — are inclined to hold themselves rather aloof from one another, except in the cases of the densely crowded spike-like heads of Grasses, like the Foxtail and the common Timothy or Herd's Grass.

Like the larger groups of the Composites, these tiny, few-flowered spikelets of the Grasses are protected by one common involucre. In place, however, of the many-bracted involucre of the former, two large and very stiff bracts are considered enough for the protection of the Grass spikelet — these being known by *the special name of Glumes*.

The Grass flower cares nothing for soft mantle or gay corolla robe. A plain, stiff, *bract-like* dress and mantle, almost exactly like the glumes of the involucre in shape, texture, and color, contents the quiet little blossom. So different are her mantle and dress from those of other flowers, and so much do they look like the "chaff" bracts among the Composite florets, that we do not even think of them by the names of calyx and corolla, but as **Pales** or **Palets**, from a Latin word meaning *chaff*.

Like the flower of the Composites, the Grass flower carries a one-celled, one-seeded pistil; but unlike them, she usually carries two styles, each with a long, plummy stigma. Her usual number of stamens is three, but she does sometimes carry more.

The filaments are extremely long and thread-like; the anthers, very large, heavy, and easily shaken by the lightest motion of the wind-swept Grass. When you remember that it is upon the wind that the Grass flower depends for the carrying of her pollen, you will at once see why the feathery, glutinous stigmas and the slender stamen stalks should, *after the ripening of the pollen grains, stretch themselves far out beyond the enveloping palets*; and why the anthers are so placed that, after being thus thrust out beyond the palets, they may rock in every direction with the least movement of the lightly swaying filaments.

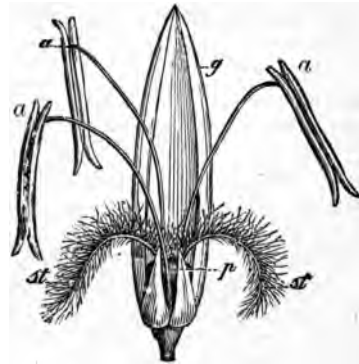


Fig. 22.

Flower of common Rye Grass: *a*, anthers; *st*, the plummy stigmas; *p*, ovary; *g*, one of the palets, the other being removed to show pistil and stamens.

The seed of the Grass flower, after fertilization, unites so closely with the ovary that the two together form one large, dry, seed-like body, which we usually speak of as a **Grain**, though botanists know it by the name of **Caryopsis**.

How much the Grasses differ among themselves in the readiness with which they give up their grains, every farmer knows to his cost; for his Wheat, his Oats, his Barley, wrap their grains away in the palets so closely that he is compelled to resort to very severe measures before the miserly Grasses will yield them up; but still, as he always expects and prepares to meet this unwillingness, I suppose that this selfish reluctance to give up the seed does not make very much difference to him. And, after all, it is the jealous, devoted care which, from first to last, the little Grass flower has lavished upon her precious grain, that makes it valuable for its great use,—that makes it worthy to become finally that great “staff of life” without which man would hardly know now how to exist.

Caryopsis: grain of Grasses.

Chaff: small bracts or scales found among the florets of Composites.

Composite: compound flower, page 53.

Culm: hollow, jointed stem of Grasses.

Floret: one of the tiny flowers forming the head of a Composite.

Glumes: bracts enveloping Grass spikelets, and corresponding to involucre of Composites.

Grain: ripened seed and ovary of Grasses.

Head: dense collection of flowers, as in Composites.

Involucre : whorl of overlapping bracts enveloping head of Composites, and corresponding to calyx of single flower.

Pales or Palets : bracts enveloping each flower of the Grasses.

Panicle : page 62.

Pappus : peculiar, spreading part of the calyx of a Composite floret.

Spike : page 62.

Spikelets : the small flower groups in a Grass spike or panicle.

CHAPTER V.

THE ELFIN FERNS.

LONG, long ago, before yet the shy little fairy elves had been frightened away by us, within our valleys, upon our hills, and along our lakes and rivers, stood the fair, peaceful groves of shadowy Elf-land.

Alas for the little Elve-folk! One by one, under the feet of the human giants, they saw their "fairy rings" destroyed, their homes laid waste, and their most secret haunts invaded. Farther and farther into woodland shades and among frowning rocks they fled, but all in vain; and with a low, despairing wail, the "little men in green" threw themselves upon the ground and prayed for a swift deliverance from their human foes.

* * * * *

A hush as of death stole through the darkening air. Overhead moved a canopy of sullen clouds. A stifling pall closed around the world. No life, no sound! Hark! what was that? A low, sobbing moan from the elves pierced the murky gloom. Again a death-like silence. Again a moan. A moment's hush; then a faint shriek of joy, a rush as of winged armies through the air, swift flashes of light, the clash of armor mingled with wild shouts of scorn and triumph, and, above all, the horrible roar of swift-rising waters.

The giant enemies of the elves cowered, panic-stricken and helpless, before the angry spirits of air and water. They saw their homes destroyed, themselves threatened with swift destruction, and from their lips arose the wild prayer for escape from a pursuing foe.

The elves were avenged. One by one, the wrathful spirits withdrew themselves, and once more the sun shone out upon a peaceful world. But what had become of the elves? And what were all these graceful, feathery forms, unseen before, now waving from every former elfin home?

I cannot tell you how it happened. That is a fairy secret, you know. But ever since that day when the elves disappeared so suddenly from our sight, the green plumes of the "fairy fern" have waved in modest triumph from every rocky cleft and woodland haunt of that long-vanished world of Elf-land.

Only the changed flower fairies still care to come up into our world; so the elfin ferns have no flower mistress. The Fern household is ruled instead by an invisible little master, far below. There is no use in your looking for him, even with a microscope. He will never be found; but as long as his root servants still live, you may be sure that he himself is not far away.

The Fern Elf has the same kind of servants as his neighboring flower friends. He has his root servants, his leaf servants, and last of all, his good old friend, Nurse Stem.

The Fern stem, having no flower to carry aloft, usually prefers to remain underground with the roots. In tropical countries, however, there are many fern plants whose ambitious stems insist

upon accompanying the leaves. Such a stem, always holding the leaves in a great cluster above her head, may continue to climb thus, year after year, until she has carried them far away, perhaps forty or fifty feet from the lonely roots below. But these great "Tree Ferns" are never to be found except in very warm climates, where they are not obliged to retreat back into the ground once a year, in order to escape the ice and snow.

The leaf servants of the Ferns are of even more importance than those of the flowers. Can you tell why? Look at the back of a Fern leaf. What do you find there? Nothing? Look at another, an older one. Do you not find a great number of little oblong bodies or round dots on the back of this one? What do you think these dots are? Seeds? No. But you are very near the truth. They are not themselves seeds, but each dot is itself a little *cluster of sac-like bags or pouches*, each one of which contains a great number of very minute seed-like bodies. You can easily see these curious, stalked pouches for yourselves by poking into the dot with the sharp point of a knife or pin.

Now can you tell me why the Fern leaf is of so much importance? Because it carries something like the seeds? Of course.

The shy Fern Elf hides away from us. His leaf servants are as shy as he, but they are compelled to do his bidding and come up into the upper world, usually without even the companionship of Nurse Stem. So frightened are they that at first they roll themselves into a little ball and steadily refuse to look about them. Indeed, I don't know that they would ever take courage enough to look around, were it not that the Fern Master, with a fellow-

sympathy for their shyness, sends them up in large groups. Nearly all of the Fern leaves come out in this manner, like the compound leaf of the flower plant.

The leaf of the Fern plant, whether single or compound, is always known as the **Fron**d, and the leaflets are known as the **Pinnæ**, from a Latin word meaning *feather*, because, if you look closely, you will see that each little pinna is shaped somewhat like a tiny feather. Oftentimes you will see that each little pinna is very much like a compound leaf itself. In such cases, the more minute leaflets are called **Pinnules**, and you might really get very tired trying to find out just how many little pinnules the Fern Master had been obliged to collect together, before either he or Nurse Stem could persuade any of them to venture up above the ground. It is a well-known fact, however, that these very shyest of pinnule leaflets unite to make some of our most graceful fronds. The very next time that you go into the woods, look and see if this is not true.

There are a few exceptional Fern leaves, among which are those of the rare "Hart's Tongue" and the restless "Walking Leaf," that are bold enough to come up without the social pinnæ and pinnules; but I think that the fearlessness of the former is entirely due to the fact that the Elfin Master hides away in places so secret that the leaves, which are really quite large, feel perfectly safe in so doing. And as for the Walking Fern, its leaves are in altogether too great a hurry to wait for one another. Did you ever see this lively little Fern? If so, you have seen what the frond does when it gets tired and wishes a change of position. Stretching itself out to a great length, it bends entirely

over, and laying firm hold of the ground, calls loudly upon Nurse Stem for help. Now the good Nurse is unable to go to his assistance herself, but she knows exactly what to do, and at once sends

up some tempting little delicacy by which he may be able to coax a few tiny roots to come to his assistance.

In this way he soon gets a firm hold, and in a short time you will see a number of little fronds eagerly hurrying up to offer their companionship.

As soon as the Elf Master and Nurse Stem have decided that it is time for the Fern household to make its appearance above the ground, they give a little push to the **Stipe** (the footstalk or petiole of the compound Fern leaf), and up goes the unwilling frond. Ter-

ribly frightened, the shrinking pinnæ, having rolled themselves into a little grayish coil, slowly creep up into the sunshine, and for some time after they have come among us, this little rolled-up ball is all that can be seen of the foolish frond.

By and by, the largest, boldest pinnæ, finding themselves un-

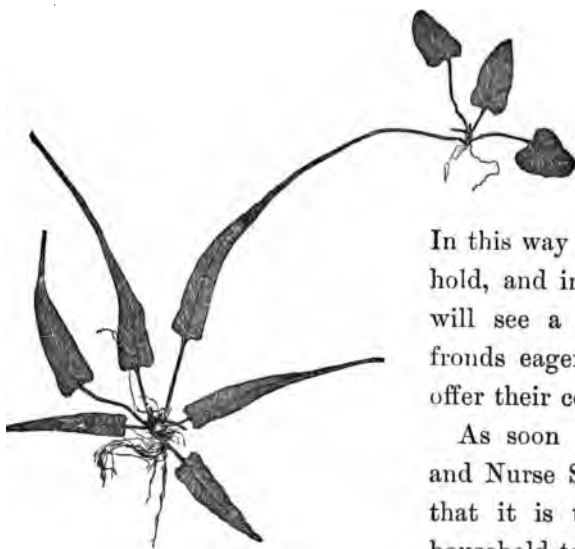


Fig. 23.

A Walking Fern found on the face of a limestone cliff; showing a leaf whose restless ambition has led to the establishment of a new household higher up in the world than the old one. (Engraved from nature; reduced one-half.)

molested, timidly peer out to see if there really is anything of which to be afraid; then, gathering courage at the apparent harmlessness of everything around, they send on word to the others, and themselves come boldly out from among their sheltering comrades. Slowly, one by one, the others follow their example, the youngest, least courageous pinnæ at the upper part of the frond being the very last to lift up their timid little heads.

I wonder if you have ever heard of the "Vegetable" or "Tartarian Lambs," about which ancient travellers used to tell such pitiful tales.

Far away on the plains of Eastern Russia, and toward the Ural Mountains, travellers used to say that a wonderful kind of lamb was to be seen. Covered with the most beautiful soft gray and reddish fleece, these lambs were attached to the ground like plants, the unfortunate little creatures



Fig. 24.
Frond of common Polypody: *a*, frond;
c, stipe; *d*, rootstock.

being forced to lie always upon their backs, in the same place. In this position, they could graze, of course, but sparingly, and only upon whatever was within their reach; and when at last there was nothing left upon which to feed, the helpless creatures slowly starved to death.

It was a sad little tale to hear of any living thing, was it not? And pictures of these lambs, lying thus upon their backs, with pitiously uplifted legs, appealed, in the most pathetic manner, to the sympathies of all who saw them.

But what do you suppose, on closer inspection, these curious lambs proved to be? Nothing more nor less than the huge rootstock and young rolled-up fronds of a gigantic *Fern*. The great rootstock, rooting itself along the ground, had been taken for the body, and its curved end for the head, of the supposed lamb; while the woolly stipes and rolled-up coils of the young ascending fronds formed the creature's uplifted woolly legs and feet.

When the Fern fronds are once fairly out, they all have a very good time. Indeed, since they look so green and fresh throughout the whole season, I think that perhaps the Fern leaves really lead happier and less anxious lives than do the leaves of the flower plants. I wonder if their not having a capricious little mistress to humor, has anything to do with this contented freshness of theirs. There is a very good reason for it, however, in the fact that the kind, shy little master hides away in places so far from the restless human people, that a "green old age" would naturally follow the peaceful lives led by his servant fronds.

You have not forgotten, I hope, what I told you that the fronds

have to do in connection with the little seed-like bodies that we found upon the ferns.

But if the work of the flower mistress, as well as that of the flower leaves, has to be done by the frond servants, you don't think that a very easy life, do I hear you say?

Listen, now. Although the fronds do have to carry these seed-like bodies and, of course, to see that they are kept alive and comfortable, yet they have no worry or discomfort about the matter. These little bodies, though they look like seeds, it is true, are not seeds at all. They are known as **Spores**, and are so small that they can be seen clearly only through the microscope. These minute spores are carefully packed away in great numbers into little stalked, closed, tissue-like bags or pouches, called **Spore-Cases** or **Sporangia**. These spore-cases are what you really saw when you first poked open the little dot on the back of the frond and thought you were seeing the seeds themselves. They are collected by their stalks into groups or clusters on the back of the frond, each little group itself looking like a single dot, and known as the *Fruit Dot* or **Sorus**. Although firmly attached to the back of the frond, yet the little cluster of spore-cases is so light, that the frond looks upon the carrying of these spore cradles as a matter of pleasure and pride, rather than a hardship.

Nearly all of the Fern Masters have the fruit dots themselves



Fig. 25.

Portion of frond of common Polypody, showing position and general appearance of the uncovered fruit dots, or sori.

protected by a special covering, known as the **Indusium**. This differs a great deal in shape, size, and texture, among the different Fern families. I think you must have found an indusium covering, or partly covering, the fruit dot at which you were looking a while ago. Didn't you find it necessary either to poke apart two long,

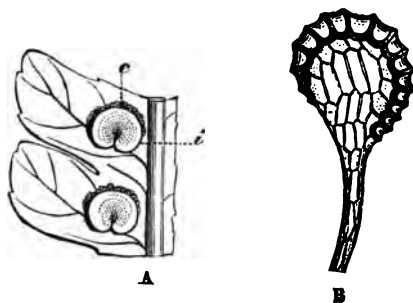


Fig. 26.

A. Portion of frond of one of the common Shield Ferns: *i*, indusium; *c*, the cluster of spore-cases, or sporangia, seen beneath.

B. A very greatly magnified view of one of these spore-cases.

thin, pod-shaped coverings, or else to take off a roundish one, placed like a little shield directly over the spore-case? Perhaps you were looking at the common Brake, which I used to call the "parasol fern," or perhaps some one had a

frond of the rarer, and far more delicate, Maiden Hair Fern. If you had either of these, then you had to lift up, and put back, a little part of the edge of the frond, which in this tender manner had tried to protect the exposed spore-cases grouped along its margin.

THE FERN SPORES AND THE FERN CHANGELING.

Now, then, will you follow out with me the lives of these little Fern spores?

Here is a lovely wood Fern. Let us watch and see what will happen. The tiny spores, sleeping so peacefully in their little

cradles, grow steadily larger and stronger, until at length there is no more room for them in the already tightly stretched spore-case. The sporangium suddenly bursts open, perhaps from the top, perhaps at the side. Out through the opening thus made, past the protecting indusium, fall, still fast asleep, the helpless spores. Most of them are probably at once borne away by the wind and never awaken.

Ah, here are a number of spores that have fallen upon the ground. Let us keep watch of this place and see if from these spores there will not come new Ferns, just as from the seeds sent abroad by the flower mistress, soon come delicate plants like her own. Week by week we visit the place. By and by we are rewarded by seeing a faint greenness beginning to spread over the ground, and we eagerly watch for the young Fern to show itself. Day after day we wait, but in vain. No Fern appears. The velvety greenness takes on a little more shape, to be sure, but after all, the place looks very much like a little moss-covered patch of ground with the moss as yet too young to take on any very definite form of its own.

What does it mean? Surely this is where the new Fern should come. What is this strange, moss-like growth in the very place where the Ferns should make their appearance?

Listen. These are little **Fern Changelings**. Never is a Fern plant to be found coming from a Fern spore. Always, in the place of the true Fern, comes this curious little elfin growth. Fancy the bitter disappointment of the first elf fronds when, after weary weeks of waiting, these stunted, elfin forms looked mischievously up from the place where belonged the slender, infant Ferns.

Listen again, and I will tell you the reason for this. But it is a fairy secret, you must remember, and one not to be repeated carelessly. It is a penalty which the elves have to pay for the elfin pranks of which they used to be so fond in their old Elf-land days. Long, long ago, however, they learned what to expect; so now they only wait patiently, as we must also do, for the coming of the rightful occupant of the place—the true Fern plant.

Think a moment now, and tell me what it was necessary for the flower seeds to have before they could be made capable of producing plants. “Oh, the pollen powder,” you say. Well, did the Fern spores, tightly shut up in their little cases, have any pollen or anything corresponding to that seed food? “Why, no; of course not,” I hear you say.

Remembering this, now we are ready to watch the movements of the Fern Changeling; only, since these little dwarfs are seldom more than one-tenth of an inch in length, they can be examined only through a powerful microscope. Let me tell you, now, that it is upon this same curious little growth, known as the **Prothallium**, that the coming of the *true* Fern depends. This Changeling Prothallium carries upon its queer, flat little body, what corresponds to the ovary of the pistil and the anther of the **stamen** in the flower families.

I do not know whether you care to know these names or not. The part corresponding to the *flower pistil* is known as the **Archegonium** in Ferns, and the tiny seed-like body found within it is called the **Oösphere**. The part corresponding to the **stamen** is the **Antheridium**, within which are found, instead of pollen

grains, a number of curious little spiral bodies known as **Antherozoids**. Water alone can set these antherozoids free from the antheridium in which they are enclosed. But once set free, they have slender hair-like "propellers" by which, for a very short time, they are enabled to move rapidly about in the water.

As in the case of the flowers, the seeds in the ovary must be fed by the pollen grains, so in that of the Prothallium, or Fern Changeling, the oöspores must be fed by the antherozoids. And out of the many, many antherozoids set free by a little water, it would be hard indeed if at least one did not reach some waiting oöspore. When this does happen, the oöspore is called an **Oöspore**, and, after a little while, is ready to send out the true fern, exactly as a seed sends out a little plant.

It was, I suppose, this mysterious, seemingly sudden upspringing of the Fern plant from a tiny, unnoticed Prothallium that led our ancestors to hold such curious ideas in regard to the Fern seed.

At first, people believed either that the ferns bore no seeds at all, or else that

"The wondrous, one-night seeding Ferne,"

as an old poet calls it, both bore and scattered its seeds on the selfsame night. Later on, however, it came to be thought that the dots upon the back of the frond must be those very seeds which had been sought so long in vain; and the curious idea, in some way or other, grew up, that if one could only get and wear these mystic seeds somewhere about him, he would thereby be made invisible. But there was only one hour in all the year in which this magic seed could be collected—that of midnight,

on St. John's Eve (or Midsummer Night) furthermore, the seeds must fall *of their own accord* into whatever was placed to receive them; and on no account was the leaf itself to be touched or shaken. In addition, the seeds not only were supposed to be jealously guarded by invisible little spirits of wood and field, who would not willingly suffer any interference with their charge, but they also were believed to have a mysterious way of disappearing at just the moment when the collector, arriving safe at home, opened his box to produce the coveted prize.

With so many difficulties in their way, then, I think we must doubt whether very many people ever succeeded in gaining this fairy power of invisibility; though, even as late as the time of Shakespeare, there were probably plenty of country people who still made the attempt as often as the Eve of St. John came around.

For a time, the tiny plant clings close to the Prothallium; but after awhile, little hair-like roots start boldly out, seeking the ground. Up climbs a queer little green body that does not look at all like a Fern leaf, but, nevertheless, really is one. New leaves, each one a little more like the real Fern frond that we know, come slowly out; and at last, after a long time, the Changeling disappears, and in its own rightful place stands the dainty green plume for whose coming we have waited through these long, weary months.

THE FERN HOUSEHOLD INCLUDES

The Root Servants.

The Stem Servants.

The Leaf or Frond Servants.

THE FROND SERVANTS.

- | | | |
|------------------|---|---|
| Habits | { | 1. May come up alone like the Walking Leaf, Hart's Tongue, etc. |
| | { | 2. May come up in groups composed of Pinnae, Pinules, etc. |
| Uses | { | 1. Same as Flower Leaves. |
| | { | 2. To carry the Fern Spores. |

THE FERN SPORES.

- | | | |
|------------------------|---|--|
| Method of Protection : | { | 1. Packed away into a Spore-Case, or Sporangium. |
| | { | 2. Sporangia collected into little groups known as Fruit Dots, or Sori. |
| | { | 3. Fruit Dot, usually protected by a special covering known as the Indusium. |

THE FERN CHANGELING, OR PROTHALLIUM.

- | | | |
|-------------------|---|---|
| Uses | { | 1. To make a seed-like body carried within itself capable of producing a new plant. |
| | { | 2. Furnishes nourishment for a time to the new Fern plantlet. |
| Carries | { | 1. Archegonia and Oöspheres (corresponding in use to pistils and young seeds of the flowering plants). |
| | { | 2. Antheridia and Antherozoids (corresponding in use to stamens and pollen grains of the flowering plants). |

Antheridium : organ on prothallium of spore-bearing plants, corresponding in use to stamen of flowering ones.

Antherozoids : minute bodies necessary for fertilization of oösphere.

Archegonium : organ on prothallium of spore-bearing plants, corresponding in use to pistil of flowering ones.

Frond : corresponding to leaf in a fern.

Indusium : protecting shield of sorus — or fruit dot — of fern.

Oösphere : minute body found within archegonium, corresponding in use to young seed of flowering plants.

Oöspore : fertilized oösphere.

Pinnæ : first divisions of frond or fern leaf.

Pinnules : first divisions of pinnæ.

Prothallium : peculiar little growth arising from a spore, and unlike the parent plant.

Sorus, or Fruit Dot : collection of sporangia, or spore-cases, on back of frond.

Sporangium : spore-case of spore-bearing plant.

Spores : small, seed-like bodies borne on back of fern fronds, from which arises a new growth unlike the parent plant.

Stipe : footstalk, or petiole, of frond.

CHAPTER VI.

THE BROWNIE SCOURING RUSHES.

LAST of all the little people to leave the old fairy world were the helpful house fairies, or Brownies. With all their liking for human companionship and their eager desire to help in the household work, even these were at length forced to own that in this great, bustling world there was no longer room for the fairy-folk, and they sadly followed their fairy and elfin neighbors out of the old fairy into the new flower world, where alone they could hope to find a life that seemed worth living. So this is why we have our "Scouring Rushes," — the *Equisetums*, — which our English friends call the Horse-tail Rushes.

You know these rushes, do you not? They are the apparently leafless, sturdy little plants, with brown, thimble or cone-shaped tops, that stand up, stiff and straight, in damp, gravelly places by the roadside in the early spring. If, perhaps, you may not have noticed these particular ones, at least you must have noticed some others of this *Equisetum* family a little later on in the summer, when each whorl of stiff, pointed, angled green branches had become a plummy, pine-like growth, so that the little patch of land covered by them seemed to be overspread by a diminutive grove of waving, pine-like forms. Or perhaps you know that other Scouring Rush, whose tall and rough green stems, tied together

into bundles, were formerly used for scouring floors. The stem of this kind is green throughout the year, but it does not don its brown cap until the summer time, much later than the brave little plants which start up so courageously in the early spring.

The Scouring Rush household, like that of the Fern, has root, stem, and leaf servants, and is also ruled by a busy little master in the earth below.

The stem servants differ greatly from those of the Fern. They always come up with the leaves, and have much more work to do than the Fern stems. They differ greatly among themselves, also, both in size and color. Some are brown; others, green. Some are very slender in proportion to their height, while others are rather stout. But they are always hollow, grooved, and jointed, each joint being protected by a sheath-like covering.

The leaf servants are very peculiar. I do not believe that, unaided, you would ever guess them to be such.

Look at one of the soft, brown-stemmed Scouring Rushes. You will see the same thing on the others, but perhaps not so plainly.

Look at the sheath covering the joints. Would you ever think that sharp-toothed sheath to be a set of *closely united leaves*? I am sure you would not; but this is what they really are supposed to be, and if you will count the teeth, you will know of how many united leaves this sheath has been formed.

The other kind of leaf servants, and really the most important, are — what do you suppose? I am sure you never would guess; so I must tell you. They are the little brown, scale-like bodies which you see, closely fitting one another, like the cells of a honey-comb, on this thimble-shaped cone which we have already

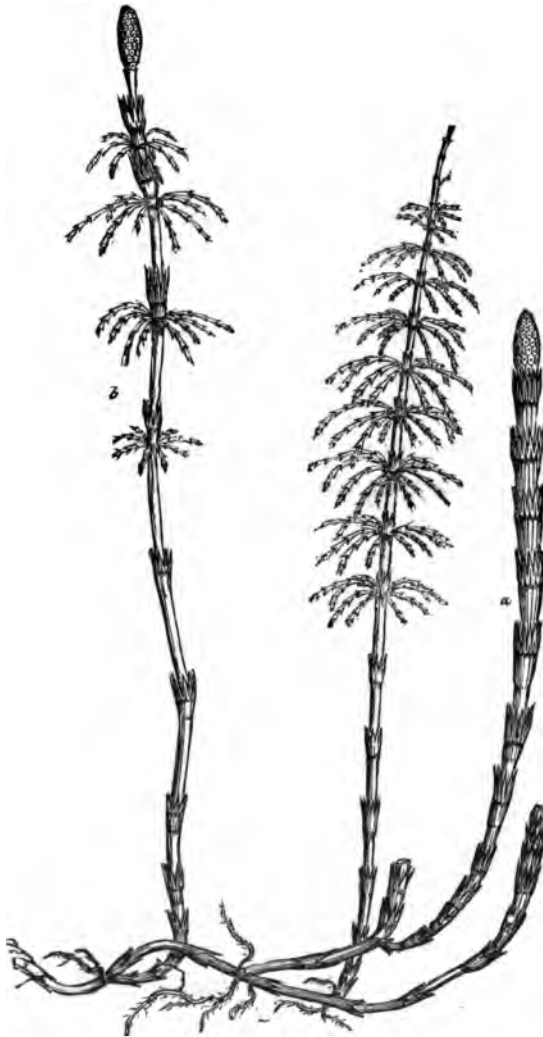


Fig. 27.

Equisetum, or Horse-tail Rush, showing the stiff, angled green branches and the two kinds of leaf servants.

noticed at the top of some of the rushes. When looked at under the microscope, these brownish, scale-like leaves are each seen to be raised upon a tiny stalk, and to bear a number of spore-cases upon the under side. Shake one of the Scouring Rush cones, taking care to choose a brown one. What do you think that thick cloud of sage-green powder is? Do I hear you wondering if it has anything to do with the spores of the Horse-tail?

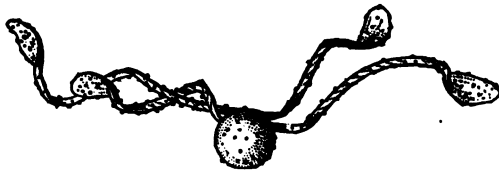


FIG. 28.

Very greatly magnified view of Spore with outstretched elaters.

You are right. What seems to be a fine green powder is really a collection of minute spores. But there is something very curious about these spores. When I look

at one under the microscope, this is what I see.

Here is a little roundish green spore with four thread-like filaments stretching out like spoon-shaped arms from its tiny body. What do you suppose they are for? Put a drop of water down among these spores. Why, what has happened? Where have the little arms gone? Did you see that the moment they felt the dampness, every arm at once coiled itself protectingly around its spore? Now remove the water and see what happens as the place grows drier and drier. Ah! Here are the little arms quickly outstretching themselves again. Now we see what these slender, elastic filaments, known as **Elaters**, have to do. The moment a particle of moisture approaches, they must at once protect the spore, both by drinking as much as possible themselves, and by getting between the approaching drop and their

charge. And do you not also see that there is something else done for the helpless spore by its elaters? Put another drop of water down among the spores, and watch closely to see what happens. Now another drop. Do you not see that with each successive coiling and uncoiling of its elaters, the tiny spore is *rolled over and over and thus sent farther and farther away from the spore-case?* So, then, we find that the elaters have not only to protect their spores, but also to aid in scattering them abroad. In dry weather, however, they have only to come out and help the sleeping spores float hither and thither through the sunny air.



Fig. 29.

Very greatly magnified view of Spore surrounded by its elaters.

Like their allies, the Ferns, the Brownie Scouring Rushes are compelled to pay the penalty for former Elf-land pranks, by seeing a mischievous changeling always coming in place of the new Rush. Like the Elfin Ferns, they also have learned the lesson of patience, and now wait without a murmur, until the Prothallium Changeling shall have chosen to make way for the true plant, and a sturdy little Equisetum shall be seen standing boldly up to face the sun and storms of this upper world.



Elaters: thread-like filaments coiling spirally around the spores of the Equisetums.



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